U. S. DEPARTMENT OF AGRICULTURE.

OFFICE OF EXPERIMENT STATIONS.

FOOD AND NUTRITION INVESTIGATIONS IN NEW JERSEY

IN

1895 and 1896.

BY

EDWARD B. VOORHEES, A. M.,

DIRECTOR NEW JERSEY AGRICULTURAL EXPERIMENT STATIONS AND PROFESSOR OF AGRICULTURE, RUTGERS COLLEGE, NEW BRUNSWICK, N. J.

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LETTER OF TRANSMITTAL.

UNITED STATES DEPARTMENT OF AGRICULTURE,
OFFICE OF EXPERIMENT STATIONS,
Washington, D. C., November 7, 1896.

SIR: I have the honor to transmit herewith a report on food and nutrition investigations in New Jersey, made in 1895 and 1896, by E. B. Voorhees, A. M., director of the New Jersey Agricultural Experiment Stations, and professor of agriculture at Rutgers College. The report includes a study of the composition and cost of bread, two bakery experiments, the composition and cost of milk in cities in New Jersey, and a dietary study of a mechanic's family. These investigations constitute a part of the inquiries made with the aid of funds appropriated by Congress "to enable the Secretary of Agriculture to investigate and report upon the nutritive value of the various articles and commodities used for human food." They were conducted under the immediate supervision of Prof. W. O. Atwater, special agent in charge of nutrition investigations, in accordance with instructions given by the Director of this Office.

In carrying out the provisions of the act above cited, representative localities have been selected in different parts of the country, in order that definite information regarding the food supply and consumption of people living under different conditions might be obtained. Dietary studies made in New England, in the South, and in the Middle West have been published. It was thought desirable to compare the food habits of the people of the Middle Atlantic States with those of other regions, and it was believed that New Brunswick, N. J., was a fairly representative locality. The New Jersey Experiment Stations have well-equipped laboratories under the direction of Professor Voorhees.

Perhaps no two factors are more important in the food economy of the people at large than the bread and milk supplies, and a more extended knowledge of this subject is very desirable. Up to the present time many investigations along these lines have had to do with securing pure foods. It was the object of the present investigations to obtain more definite information as to the chemical composition of bread and milk and to secure accurate data regarding the relation of their selling price to the actual cost of their production.

Professor Voorhees's report is submitted, with the recommendation that it be published as Bulletin No. 35 of this Office.

Respectfully,

A. C. TRUE,
Director.

HON. J. STERLING MORTON,
Secretary of Agriculture.

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FOOD AND NUTRITION INVESTIGATIONS IN NEW JERSEY IN 1895 AND 1896.

During the winters of 1894–95 and 1895–96 the New Jersey Experiment Station made, in cooperation with the U. S. Department of Agriculture, a series of studies of human food. The subjects were: (1) The composition and cost of bread in New Jersey, (2) bakery experiments, (3) the composition and cost of milk in cities in New Jersey, and (4) a dietary study.

COMPOSITION AND COST OF BREAD IN NEW JERSEY.

The objects of this work were to secure (1) definite data in regard to the variations in the cost per pound of bread, and (2) positive information concerning the variations that exist in the composition of bread, and the relative cost per pound of the nutrients contained in it.

Samples of bread were secured from New Brunswick, Trenton, Newark, and Camden. All the bakers of New Brunswick are represented with one or more samples. In the other cities samples were taken from the leading bakers only.

In all cases inquiry was made as to the weight of the different loaves. In New Brunswick it was found that the majority of bakers claimed a definite weight for the loaves; in the other cities only a few made any claim, those in charge of the shop stating that the weight was seldom asked. Where the weight of loaf was given the actual weight was found to be lower in nearly every case, and in many instances so much lower as to indicate either that the weight given was purposely overstated or that the actual weight was not known. In other cases the variations could be accounted for by the natural loss of moisture during the transit of the samples to the laboratory.

The samples were always taken in the morning and prepared for analysis immediately upon their receipt in the laboratory; thus the results show the composition of what may be regarded as fresh bread. In all 77 samples were analyzed. The prices given are those charged to regular customers.

Table 1 gives the weight, cost, and a brief description of the different loaves of bread. Tables 2 and 3 contain the analyses of the bread as received. In most cases the samples taken for analysis represented one quarter of the loaf so cut that the quarter would contain its due proportion of crust. The samples were air-dried at a temperature of 65° F., and then prepared and analyzed according to the official methods for food analyses.[1]

[1] U. S. Dept. Agr., Division of Chemistry Bul. 8.

TABLE 1.—*Weight and cost of different loaves of bread.*

Laboratory number.	Place of purchase.	Date of purchase.	Trade name.	Claimed weight of loaf.		Actual weight of loaf.		Cost of loaf.	Cost per pound.	
									Claimed weight.	Actual weight.
				Lbs.	*Gms.*	*Lbs.*	*Gms.*	*Cts.*	*Cts.*	*Cts.*
		1894.								
913	New Brunswick	Dec. 19	None	1.87	849	1.37	622	8	4.3	5.8
914	do	do	do	1.12	509	.93	424	4	4.0	4.5
915	do	do	do	......	None.	1.42	645	7	......	4.9
916	do	do	Milk	1.56	708	1.56	706	8	5.1	5.1
917	do	do	None	1.50	679	1.50	677	6	4.0	4.0
918	do	do	do	1.00	454	1.01	458	3	3.0	3.0
919	do	do	do	1.87	849	1.71	777	7	3.8	4.1
921	do	do	do	1.87	849	1.64	746	7	3.8	4.0
923	do	do	Milk	1.75	792	1.47	667	7	4.0	4.8
924	do	do	None	1.62	736	1.48	672	6	3.7	4.1
925	do	do	do	1.12	509	1.03	469	3	2.6	2.9
926	do	do	do	1.75	792	1.52	691	3	......	3.2
927	do	do	do	1.75	792	1.52	691	8	4.7	5.3
929	do	do	do	1.62	736	1.64	745	8	4.9	4.9
931	do	do	do	1.50	679	1.48	670	6	4.0	4.1
933	do	do	do	1.75	792	1.64	745	7	4.0	4.3
934	do	do	do	1.00	454	.97	442	4	4.0	4.1
935	do	do	do	1.80	821	1.82	825	8	4.4	4.4
937	do	do	do	1.75	792	1.62	737	7	4.0	4.3
938	do	do	do	1.00	454	.96	435	4	4.0	4.2
939	do	do	do	1.75	792	1.64	742	7	4.0	4.3
940	do	do	do	1.25	566	1.18	537	5	4.0	4.2
941	do	do	do	1.00	454	1.00	455	4	4.0	4.0
942	do	do	do	1.12	509	.97	441	4	3.6	4.1
943	do	Dec. 20	Milk	2.25	1,019	1.65	750	7	3.1	4.2
944	do	do	None	2.25	1,019	1.63	740	7	3.1	4.3
945	do	do	do	......	None.	1.44	653	7	......	4.9
947	do	do	do	......	None.	1.01	460	4	......	3.9
948	do	do	Milk	......	None.	1.07	487	4	......	3.7
949	do	do	None	1.50	679	1.56	709	8	5.3	5.1
950	do	do	Split	.94	425	.95	429	4	4.2	4.2
951	do	do	None	.94	425	.89	402	4	4.2	4.5
952	do	do	Milk	.94	425	.93	421	4	4.2	4.3
953	do	do	do	1.75	792	1.60	726	7	4.0	4.4
954	do	do	None	1.62	736	1.52	688	6	3.7	4.0
	Average									4.3
		1895.								
955	Trenton	Jan. 3	Bottom baked	1.73	784	1.89	857	10	5.8	5.3
956	do	do	None	1.05	476	1.02	462	5	4.8	4.9
957	do	do	New England	2.00	907	2.01	919	10	5.0	5.0
958	do	do	do	1.00	454	1.03	465	5	5.0	4.9
959	do	do	Cream	......	None.	1.56	706	10	......	6.4
960	do	do	None	......	None.	.96	436	4	......	4.2
961	do	do	Vienna	......	None.	.93	421	4	......	4.3
962	do	do	Home Made	......	None.	1.90	864	10	......	5.3
963	do	do	Mark Loaf	......	None.	1.06	481	5	......	4.7
964	do	do	New England	......	None.	1.66	754	8	......	4.8
965	do	do	do	......	None.	.81	367	4	......	4.9
966	do	do	Vienna	......	None.	.90	406	4	......	4.5
967	do	do	N. Y. Home Made	.90	404	.95	430	4	4.8	4.2
968	do	do	New England	.90	404	.91	412	4	4.8	4.4
969	do	do	Cream	......	None.	1.39	632	8	......	5.7
970	do	do	Pan Loaf	......	None.	.79	360	4	......	5.0
	Average									4.9
1017	Newark	Feb. 1	Vienna	......	None.	1.23	557	3	......	2.4
1018	do	do	Family	......	None.	1.40	633	3	......	2.2
1019	do	do	Gluten [1]	......	None.	1.31	592	3	......	2.3
1020	do	do	Vienna	......	None.	1.08	492	5	......	4.6
1021	do	do	Home Made Green	......	None.	1.19	542	6	......	5.0
1022	do	do	New England	......	None.	2.01	910	8	......	4.0
1023	do	do	Rolling Pin	......	None.	1.69	768	6	......	3.5
1024	do	do	Biscuit	......	None.	2.34	1,060	10	......	4.3
1025	do	do	Vienna	......	None.	1.24	562	5	......	4.0
1026	do	do	Home Made	......	None.	1.22	555	5	......	4.1
1027	do	do	Vienna	......	None.	1.08	490	5	......	4.6
1028	do	do	New England	......	None.	1.15	522	5	......	4.4
1029	do	do	Split	......	None.	1.11	505	5	......	4.5
1030	do	do	Vienna	......	None.	1.36	617	4	......	2.9
1031	do	do	Patent	......	None.	1.10	498	4	......	3.6
1032	do	do	Home Made	......	None.	2.28	1,035	6	......	2.6
	Average									3.8

[1] Not included in the average.

TABLE 1.—*Weight and cost of different loaves of bread*—Continued.

Laboratory number.	Place of purchase.	Date of purchase.	Trade name.	Claimed weight of loaf.		Actual weight of loaf.		Cost of loaf.	Cost per pound.	
									Claimed weight.	Actual weight.
		1895.		*Lbs.*	*Gms.*	*Lbs.*	*Gms.*	*Cts.*	*Cts.*	*Cts.*
1040	Camden	Mar. 2	Brick	......	None.	1.07	485	5	......	4.7
1041	.....do	....do	Home Made	......	None.	1.35	611	5	......	3.7
1042	.....do	....do	Cream	......	None.	1.03	465	5	......	4.9
1043	.....do	....do	Home Made	......	None.	1.02	463	5	......	4.9
1044	.....do	....do	Vienna	......	None.	.98	446	5	......	5.1
1045	.....do	....do	.....do	......	None.	.95	429	5	......	5.3
1046	.....do	....do	Cream	......	None.	.99	450	5	......	5.0
1047	.....do	....do	Home Made	......	None.	1.15	523	4	......	3.5
1048	.....do	....do	Vienna	......	None.	1.12	510	4	......	3.6
1049	.....do	....do	Home Made	......	None.	.95	431	5	......	5.3
1050	.....do	....do	.....do	......	None.	.99	450	4	......	4.0
1051	.....do	....do	.....do	......	None.	.99	451	5	......	5.1
	Average	....	....	......	......	......	......	......	......	4.6

TABLE 2.—*Composition of fresh bread as purchased.*

Laboratory number.	Place of purchase.	Water.	Protein.	Fat.	Carbohydrates.	Ash.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
913	New Brunswick	39.06	9.16	0.96	49.65	1.17
914	.....do	37.95	9.35	.94	50.42	1.34
915	.....do	39.05	10.32	1.74	47.94	1.05
916	.....do	34.79	10.80	2.78	50.24	1.39
917	.....do	38.11	10.51	1.89	48.49	1.00
918	.....do	36.99	10.65	1.79	49.67	.90
919	.....do	34.24	11.27	1.08	52.55	.86
921	.....do	36.67	9.20	1.92	50.92	1.29
923	.....do	38.80	9.07	1.51	49.22	1.40
924	.....do	35.99	9.58	1.10	51.88	1.45
925	.....do	35.85	9.46	1.12	52.17	1.40
926	.....do	38.56	8.91	1.56	49.42	1.55
927	.....do	35.49	9.15	1.81	52.52	1.03
929	.....do	35.60	8.68	1.10	53.27	1.35
931	.....do	40.06	9.08	.67	49.10	1.09
933	.....do	38.60	8.54	.20	51.77	.89
934	.....do	38.12	8.62	.27	52.12	.87
935	.....do	41.20	8.65	.06	49.18	.91
937	.....do	34.89	9.76	2.39	51.54	1.42
938	.....do	35.49	9.63	1.71	51.83	1.29
939	.....do	36.06	9.15	1.62	52.00	1.17
940	.....do	36.39	9.21	1.41	51.95	1.04
941	.....do	37.13	9.10	1.71	50.94	1.12
942	.....do	39.29	8.58	.46	50.87	.80
943	.....do	39.77	8.77	.33	50.23	.90
944	.....do	39.71	8.56	.48	50.41	.84
945	.....do	43.81	11.09	.84	43.04	1.22
947	.....do	33.55	10.92	.85	53.64	1.04
948	.....do	34.44	10.68	1.63	51.94	1.31
949	.....do	36.36	9.52	1.64	51.23	1.25
950	.....do	35.24	9.57	1.49	52.40	1.30
951	.....do	38.33	8.68	2.14	49.00	1.85
952	.....do	34.15	9.47	1.61	53.68	1.09
953	.....do	38.38	8.96	2.05	49.04	1.57
954	.....do	35.89	9.77	.82	52.16	1.36
	Average	37.26	9.50	1.31	50.74	1.19
955	Trenton	35.30	8.89	3.10	51.21	1.50
956	.....do	36.27	8.50	3.31	50.52	1.40
957	.....do	39.80	8.65	1.52	48.75	1.28
958	.....do	37.38	8.94	1.20	51.56	.92
959	.....do	38.19	8.94	.91	50.76	1.20
960	.....do	35.42	9.74	.22	53.54	1.08
961	.....do	34.17	9.80	.85	54.26	.92

TABLE 2.—*Composition of fresh bread as purchased*—Continued.

Laboratory number.	Place of purchase.	Water.	Protein.	Fat.	Carbohydrates.	Ash.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
962	Trenton	37.89	9.37	0.42	51.55	0.77
963	.....do	35.23	9.27	.55	54.23	.72
964	.....do	36.12	9.14	.93	53.05	.76
965	.....do	33.07	9.57	.92	55.30	1.14
966	.....do	34.05	9.71	1.16	53.78	1.30
967	.....do	35.41	8.89	1.95	52.93	.82
968	.....do	33.86	9.11	2.06	54.08	.89
969	.....do	33.32	9.91	.14	55.71	.92
970	.....do	32.71	9.92	.17	56.24	.96
	Average	35.51	9.27	1.21	52.97	1.04
1017	Newark	30.24	11.01	2.19	55.20	1.36
1018	.....do	31.81	10.73	2.31	53.81	1.34
1020	.....do	32.54	10.08	.54	55.74	1.10
1021	.....do	34.24	9.27	2.44	52.82	1.23
1022	.....do	40.51	8.47	.55	49.13	1.34
1023	.....do	36.43	8.76	.83	52.77	1.21
1024	.....do	39.70	8.27	.63	50.12	1.28
1025	.....do	36.12	8.95	.30	53.47	1.16
1026	.....do	36.99	8.76	.36	52.87	1.02
1027	.....do	33.83	9.91	1.04	54.04	1.18
1028	.....do	35.66	9.88	1.01	52.45	1.00
1029	.....do	35.43	9.17	.63	53.86	.91
1030	.....do	35.47	9.19	.47	53.95	.92
1031	.....do	49.09	7.61	.37	42.03	.90
1032	.....do	35.33	9.35	.75	53.28	1.29
	Average	36.23	9.29	.96	52.37	1.15
1040	Camden	31.01	9.56	3.71	54.84	.88
1041	.....do	35.45	9.16	1.71	52.82	.86
1042	.....do	31.80	9.32	1.39	56.55	.94
1043	.....do	34.99	9.04	1.31	53.73	.93
1044	.....do	30.63	8.61	3.80	55.90	1.06
1045	.....do	34.86	9.29	.50	54.45	.90
1046	.....do	37.12	8.97	.54	52.58	.79
1047	.....do	35.07	8.99	.99	53.93	1.02
1049	.....do	35.47	9.03	.52	54.02	.96
1050	.....do	33.93	9.88	.94	54.36	.89
1051	.....do	32.49	9.51	2.41	54.34	1.25
	Average	34.23	9.13	1.57	54.12	.95
	Average composition of all	35.81	9.30	1.26	52.55	1.08

TABLE 3.—*Composition of water-free substance of bread.*

Laboratory number.	Place of purchase.	Dry matter.	In dry matter.			
			Protein.	Fat.	Carbohydrates.	Ash.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
913	New Brunswick	60.94	15.02	1.57	81.50	1.91
914	.....do	62.05	15.07	1.51	81.27	2.15
915	.....do	60.95	16.77	2.85	78.65	1.73
916	.....do	65.21	16.56	4.26	77.04	2.14
917	.....do	61.89	16.98	3.06	78.36	1.60
918	.....do	63.01	16.90	2.85	78.82	1.43
919	.....do	65.76	17.13	1.65	79.92	1.30
921	.....do	63.33	14.53	3.04	80.40	2.03
923	.....do	61.20	14.82	2.46	80.43	2.29
924	.....do	64.01	14.97	1.72	81.05	2.26
925	.....do	64.15	14.75	1.75	81.32	2.18
926	.....do	61.44	14.50	2.54	80.43	2.53
927	.....do	64.51	14.19	2.81	81.41	1.59
929	.....do	64.40	13.48	1.70	82.73	2.09
931	.....do	59.94	15.16	1.12	81.90	1.82
933	.....do	61.40	13.91	.33	84.32	1.44
934	.....do	61.88	13.93	.43	84.23	1.41
935	.....do	58.80	14.70	.10	83.65	1.55

TABLE 3.—*Composition of water-free substance of bread*—Continued.

Laboratory number.	Place of purchase.	Dry matter.	In dry matter.			
			Protein.	Fat.	Carbohydrates.	Ash.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
937	New Brunswick	65.11	14.99	3.67	79.16	2.18
938	....do	64.51	15.00	2.66	80.34	2.00
939	....do	63.94	14.31	2.54	81.31	1.84
940	....do	63.61	14.48	2.22	81.67	1.63
941	....do	62.87	14.47	2.73	81.02	1.78
942	....do	60.71	14.14	.76	83.78	1.32
943	....do	60.23	14.39	.54	83.58	1.49
944	....do	60.29	14.20	.80	83.61	1.39
945	....do	56.19	16.76	1.27	80.12	1.85
946	....do	64.29	16.09	.36	81.18	2.37
947	....do	66.45	16.44	1.28	80.72	1.56
948	....do	65.56	16.28	2.48	79.24	2.00
949	....do	63.64	14.95	2.65	80.44	1.96
950	....do	64.76	14.77	2.30	80.92	2.01
951	....do	61.67	14.07	3.47	79.46	3.00
952	....do	65.85	14.38	2.45	81.52	1.65
953	....do	61.62	14.54	3.32	79.59	2.55
954	....do	64.11	15.24	1.28	81.37	2.11
	Average	62.78	15.05	2.01	81.01	1.89
955	Trenton	64.70	13.75	4.79	79.15	2.31
956	....do	63.72	13.34	5.20	79.26	2.20
957	....do	60.20	14.37	2.52	80.98	2.13
958	....do	62.62	14.28	1.91	82.35	1.46
959	....do	61.81	14.46	1.47	82.13	1.94
960	....do	64.58	15.09	.34	82.90	1.67
961	....do	65.83	14.89	1.31	82.40	1.40
962	....do	62.11	14.28	.67	83.81	1.24
963	....do	64.77	14.31	.85	83.74	1.10
964	....do	63.88	14.30	1.45	83.06	1.19
965	....do	66.93	14.30	1.38	82.61	1.71
966	....do	65.95	14.94	1.76	81.33	1.97
967	....do	64.59	13.77	3.02	81.95	1.26
968	....do	66.14	13.78	3.11	81.77	1.34
969	....do	66.68	14.87	.21	83.54	1.38
970	....do	67.29	14.74	.25	83.59	1.42
	Average	64.49	14.34	1.89	82.15	1.61
1017	Newark	69.76	15.78	3.14	79.13	1.95
1018	....do	68.19	15.73	3.39	78.91	1.97
1019[1]	....do	64.29	17.28	3.70	75.64	3.38
1020	....do	67.46	14.94	.81	82.63	1.62
1021	....do	65.76	14.09	3.71	80.33	1.87
1022	....do	59.49	14.24	.93	82.58	2.25
1023	....do	63.57	13.78	1.30	83.01	1.91
1024	....do	60.30	13.72	1.04	83.12	2.12
1025	....do	63.88	14.02	.47	83.69	1.82
1026	....do	63.01	13.90	.56	83.91	1.63
1027	....do	66.17	14.98	1.57	81.67	1.78
1028	....do	64.34	15.37	1.56	81.52	1.55
1029	....do	64.57	14.21	.97	83.41	1.41
1030	....do	64.53	14.24	.72	83.61	1.43
1031	....do	50.91	14.96	.72	82.55	1.77
1032	....do	64.67	14.46	1.16	82.39	1.99
	Average	63.81	14.79	1.61	81.71	1.90
1040	Camden	68.99	13.74	5.38	79.60	1.28
1041	....do	64.55	14.19	2.64	81.87	1.30
1042	....do	68.20	13.67	2.04	82.92	1.37
1043	....do	65.01	13.91	2.01	82.66	1.42
1044	....do	69.37	12.41	5.47	80.60	1.52
1045	....do	65.14	14.26	.77	83.59	1.38
1046	....do	62.88	14.26	.85	83.64	1.25
1047	....do	62.10	13.25	1.56	83.69	1.50
1048	....do	64.93	13.84	1.54	83.05	1.57
1049	....do	64.53	14.00	.80	83.72	1.48
1050	....do	66.07	14.95	1.42	82.29	1.34
1051	....do	67.51	12.60	3.57	81.98	1.85
	Average	65.77	13.75	2.34	82.47	1.44

[1] Not included in average.

DISCUSSION OF RESULTS OF ANALYSES.

The variations in the composition of bread are chiefly due to two causes: (1) The variations in the composition of the flour used, which may cause changes in two directions, (a) in the amount of water that may be absorbed by the bread, and (b) in the proportions of protein, fats, and carbohydrates; (2) the different methods used by bakers in making the bread. In some cases only flour, yeast, and salt are used, while in others milk, butter, sugar, and lard, either alone or in combination, are added.

It may be seen from the tables that the widest range in the constituents directly determined is in the water, and the next widest in the fat. The percentage of fat increases with the amount of milk or butter added to the bread. If only sugar (a nearly pure carbohydrate) is added, the percentage of carbohydrates is increased and that of fat and protein is correspondingly reduced, otherwise the carbohydrates vary with the variation of the other constituents, because obtained by difference.

In the samples of bread from New Brunswick the water ranges from 34.15 to 43.81 per cent; the fat from 0.06 to 2.78 per cent, and the protein from 8.56 to 11.5 per cent. The variations in moisture are doubtless due to differences in the absorbing power of the different kinds of bread, since all were taken the same day and prepared for drying as rapidly as possible after their receipt in the laboratory. The variations in fat[1] are due both to differences in composition of dough, as already stated, and to the fact that in the process of baking the fats are either destroyed or rendered nonextractable.

The fat in sample No. 235 is much lower than could have resulted from the use of any brand of flour. Marked variations and an unusually high protein content are due in many cases to the addition of milk to the bread.

Bread from Trenton, Newark, and Camden varies in composition in the same directions as indicated for that from New Brunswick, showing that the methods of making bread are the same in all these cases. The average composition of the bread from the different places is quite uniform, the bread from New Brunswick showing less total dry matter than that from the other places. This is doubtless due to the fact that a shorter time elapsed between the baking and the preparation of the bread for analysis, and hence there was less opportunity for the escape of moisture. The protein is the substance least affected by difference in methods of making, and is remarkably uniform in amount in the different breads.

The variations in the average cost of bread in the different cities is also interesting. In Newark, it is cheapest, averaging 3.8 cents per pound; in Trenton, it is most expensive, averaging 4.9 cents per pound, the difference being 1.1 cents per pound, or 29 per cent. Assuming that

[1] By fat is meant "ether extracts."

an average family of five persons consume 1,000 pounds of bread per year, which is a fair assumption, it would cost $38 in Newark and $45 in Trenton, if bought at the average price.

In the following table the average composition of the fresh bread and of the dry matter is compared with the average composition of wheat flour:

TABLE 4.—*Average composition of bread and of wheat flour.*

	In original substance.					In dry matter.			
	Water.	Fat.	Protein.	Ash.	Carbohydrates.	Fat.	Protein.	Ash.	Carbohydrates.
	Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
Bread	35.81	1.26	9.30	1.08	52.55	1.97	14.49	1.69	81.85
Flour	12.00	1.00	12.00	1.00	74.00	1.14	13.63	1.14	84.09

A further discussion of the relation of the nutrients contained in bread and in flour will be found on page 18.

The cost of bread.—The prices range from 3 to 10 cents per loaf. The average weight and price per loaf and the cost per pound of bread are given in the following table:

TABLE 5.—*Weight and price per loaf and cost per pound of bread.*

Number of loaves.	Cost per loaf.	Average weight.	Average cost per pound of bread.	Weight of heaviest loaf.	Weight of lightest loaf.	Difference in weight of loaf.	Percentage difference in weight.[1]
	Cents.	*Pounds.*	*Cents.*	*Pounds.*	*Pounds.*	*Pounds.*	
5	10	1.98	5.3	2.34	1.56	0.78	50
8	8	1.62	5.0	2.01	1.37	.64	46
11	7	1.59	4.4	1.71	1.42	.29	21
7	6	1.62	3.9	2.28	1.19	1.09	91
10	5	1.08	4.7	1.35	.95	.40	42
22	4	.98	4.1	1.36	.79	.57	71
5	3	1.12	2.7	1.39	.95	.44	47

[1] Expressed in percentages of the weight of the lightest loaf.

The 3, 4, and 5 cent loaves were practically pound loaves; the 6, 7, and 8 cent loaves averaged a little more than 1½ pounds, and the 10-cent loaves weighed about 2 pounds.

A study of Table 5 shows, first, that the relation of cost per loaf to cost per pound of bread varies greatly; as a rule, the greater the cost per loaf the higher the cost per pound of bread. In the 10-cent loaf the bread costs on the average 5.3 cents per pound; in the 3-cent loaf it costs but 2.7 cents. That is, one dollar expended for bread at 3 cents per loaf would purchase just double the amount of bread that could be bought at 10 cents per loaf. At 8 cents per loaf the bread costs 5 cents per pound; at 4 cents it costs but 4.1 cents per pound, a difference not so great, but too great unless a proportionately increased amount of actual nutrients is furnished, which is not the case. In the second place, it is shown that there is a lack of uniformity on the part of the bakers in reference to the fixing of prices, the difference in weight of the same priced loaf ranging from 21 per cent for the 7-cent loaf to 91 per cent for the

6-cent loaf. The least variation is shown to be in the 7-cent loaf and the greatest in the 6-cent loaf. That is, in one 10-cent loaf over 2 pounds of bread are furnished, which costs 4.3 cents per pound; in another 10-cent loaf but little more than 1½ pounds is furnished, which costs 6.4 cents per pound. The composition of the bread of the higher-priced loaf, as shown by analysis, differs but little from that of the lower-priced one, the more expensive loaf containing slightly more dry matter. In all cases the quality of the bread, from an edible standpoint, was all that could be desired.

The results of these investigations, conducted for the sole purpose of securing exact information, indicate strongly that the standard by which sales are now made and which is expressed by the term "loaf" should be changed, because it is a variable standard, and the term "pound of bread" should be adopted instead, or that a standard loaf should contain a definite number of pounds or ounces.

If this were the case, a loaf of bread would, within the limits of variation in composition, contain a certain amount of nutriment. If under such a standard a consumer preferred to pay more per pound for one loaf than another, he would do so with the full knowledge that for the greater price he was not securing a proportionately increased amount of nutriment.

BAKERY EXPERIMENTS.

The process of baking bread and the changes which the materials composing it undergo in baking have been summed up as follows:

"In making the bread, a little butter or lard, salt, and yeast, and considerable water, either by itself or in milk, are added to the flour. The yeast causes carbohydrates (sugar, etc.) to ferment, yielding alcohol and carbonic acid in the form of gas, which makes the dough porous. In the baking, the alcohol is changed to vapor and the carbonic acid is expanded, making the bread still more porous, and both are mostly driven off. Part of the water escapes with them. The amount of sugar and other carbohydrates lost by the fermentation is not very large, generally 1½ to 2 per cent of the weight of the flour used. With the increase in the proportion of water in the bread as compared with the flour, the proportion of nutriment is diminished, but the addition of shortening and salt brings up the fat and minerals in the bread, so that the proportions are larger than in the flour. In practice, 100 pounds of flour will make from 133 to 137 pounds of bread, an average being about 136 pounds."[1]

Two experiments were made to secure more definite information concerning these points. These experiments were conducted in a well-equipped bakery in New Brunswick, from which the total daily output of wheat bread averaged about 500 loaves, one half of which were large (1.88 pounds) and one half small (1.12 pounds) loaves. The entire work was under the immediate supervision of the writer, and an official of the experiment station weighed accurately the flour, butter, lard, sugar, yeast, and salt that were used in making the bread. He remained at the bakery during the entire time, from the weighing of the materials until the bread was baked. The total weight of the

[1] U. S. Dept. Agr., Farmers' Bul. 23.

bread made was then obtained, and samples of each kind and of the materials used were taken for analysis.

The analyses of materials and of baked bread and the actual quantity of nutrients contained in each are shown for the first experiment in Table 6 and for the second experiment in Table 7.

TABLE 6.—*Weights, composition, and nutrients of materials used and bread made.*

[Experiment No. 1, Jan. 10, 1895.]

	Laboratory number.	Weights.	Composition.					Nutrients.		
			Water.	Protein.	Fat.	Carbohydrates.	Ash.	Protein.	Fat.	Carbohydrates.
Materials used:		*Grams.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Grams.*	*Grams.*	*Grams.*
Flour No. 1	989	36,288	12.49	13.09	1.16	72.77	0.49	4,750.1	420.9	26,406.8
Flour No. 2	990	45,814	14.40	10.88	1.00	73.26	.46	4,984.6	458.1	33,563.3
Butter	991	754	14.76	.99	81.51	....	2.74	7 5	614.6	....
Lard	992	1,143	....	....	100.00	....	....	....	1,143.0	....
Sugar	....	900	....	....	....	100.00	....	....	....	900.0
Yeast	1033	450	65.14	11.72	.38	21.00	1.76	52.7	1.7	94.5
Salt	....	1,140	....	....	....	....	....	....	....	....
Total	....	....	....	....	....	....	....	9,795.0	2,638.3	60,964.6
Baked bread:										
76 loaves (without sugar)	994	58,634	37.54	8.42	.55	52.44	1.05	4,937.0	322.5	30,747.7
92 loaves (with sugar)	993	57,486	36.40	8.50	1.41	52.63	1.06	4,886.0	810.6	30,254.9
Total	....	....	....	....	....	....	....	9,823.0	1,133.1	61,002.6

TABLE 7.—*Weights, composition, and nutrients of materials used and bread made.*

[Experiment No. 2, Jan. 31, 1895.]

	Laboratory number.	Weights.	Composition.					Nutrients.		
			Water.	Protein.	Fat.	Carbohydrates.	Ash.	Protein.	Fat.	Carbohydrates.
Materials used:		*Grams.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Grams.*	*Grams.*	*Grams.*
Flour	1014	67,926.6	12.38	12.72	1.28	73.22	0.40	8,641	869.5	49,735.9
Butter	1013	907.2	13.00	.82	83.63	....	2.55	7	758.7	....
Lard	....	907.2	....	....	100.00	....	....	....	907.2	....
Sugar	....	907.2	....	....	....	100.00	....	....	....	907.2
Yeast	1033	453.6	65.14	11.72	.38	21.00	1.76	53	1.7	95.3
Salt	....	1,020.6	....	....	....	....	....	....	....	....
Total	....	....	....	....	....	....	....	8,701	2,537.1	50,738.4
Baked bread:										
68 loaves (without sugar)	1016	50,475.0	37.76	9.11	0.64	51.24	1.25	4,598	323.0	25,863.5
81 loaves (with sugar)	1015	47,891.0	37.34	8.54	1.49	51.44	1.19	4,090	713.6	24,635.3
Total	....	....	....	....	....	....	....	8,688	1,036.6	50,498.8

In each experiment butter and lard in the amounts recorded were added to approximately one half of the total quantity of dough, and to the other half nothing was added.

The tables show that in experiment No. 1 the protein contained in the bread was slightly more, and in No. 2 it was slightly less, than the amount in the materials used. These variations are so slight that it

may be safely said that no loss of protein occurs in the changes which take place in making bread.

In experiment No. 1 it will be seen that the bread contained 38 grams more carbohydrates than was contained in the materials used; in experiment No. 2 it contained 239.6 grams less. That there is a loss of carbohydrates caused by fermentation equal to from 1½ to 2 per cent of the weight of the flour used, is therefore not shown by this work.

Both experiments showed a very considerable loss of fat during baking; that is, the fats showed by analysis to be contained in the materials used were not found in the baked bread.

This deficiency was apparent both in the bread made from flour to which fat had been added, and that to which no fat had been added. In experiment No. 1, 2,638.3 grams of fat were contained in materials used, while only 1,133.1 grams were found in the baked bread, showing a loss of 1,505.2 grams, or 57 per cent of the total fat used. In experiment No. 2, 2,537.1 grams were used, and only 1,036.6 recovered, showing a loss of 1,500.5 grams, or 59 per cent of the total amount used.

The total loss of dry matter which occurs in the process of baking is shown by these experiments to be less than 3 per cent. The work also indicates that it falls chiefly upon the fat. It was not altogether certain, however, that this loss of fat, though apparent, was an actual loss, since the fat, shown by analysis to be contained in the flour and other materials, might have been rendered nonextractable by the process of baking.

In order to study this point further, the fuel value of the various materials was both calculated and determined. By fuel value is meant the capacity of the various materials to yield heat. The results of measurements of fuel value are expressed in calories. A calorie is the amount of heat necessary to raise the temperature of a pound of water 4° F.

The calories in each of the three classes of nutrients are on the average as follows:

Calories in different classes of nutrients.

	Calories.
In 1 pound of protein	1,860
In 1 pound of fats	4,220
In 1 pound of carbohydrates	1,860

These values were used in calculating the fuel value of the bread and of the materials from which it was made. The actual determinations of the fuel value of the bread and materials were made by the Connecticut Storrs Station with a bomb calorimeter.[1] The calculated and determined fuel values are shown in tables 8 and 9.

[1] For description of bomb calorimeter see Bulletin 21 of this Office.

TABLE 8.—*Fuel value of materials used and bread made.*

[Bakery experiment No. 1.]

	Calculated from analyses.				Total determined by bomb calorimeter.
	Protein.	Fat.	Carbohydrates.	Total.	
Materials used:	*Calories.*	*Calories.*	*Calories.*	*Calories.*	*Calories.*
Flour No. 1	19, 475	3, 915	108, 264	131, 654	146, 785
Flour No. 2	20, 438	4, 259	137, 608	162, 305	181, 149
Butter	30	5, 719		5, 749	5, 890
Lard		10, 630		10, 630	10, 944
Sugar			3, 690	3, 690	3, 690
Yeast	216	15	387	518	733
Total	40, 159	24, 538	249, 849	314, 546	349, 191
Bread baked:					
76 loaves (without sugar)	20, 241	3, 000	126, 065	149, 306	166, 110
92 loaves (with sugar)	20, 034	7, 539	124, 046	151, 619	167, 399
Total	40, 275	10, 539	250, 111	300, 925	333, 509

TABLE 9.—*Fuel value of materials used and bread made.*

[Bakery experiment No. 2.]

	Calculated from analyses.				Total determined by bomb calorimeter.
	Protein.	Fat.	Carbohydrates.	Total.	
Materials used:	*Calories.*	*Calories.*	*Calories.*	*Calories.*	*Calories*
Flour	35, 425	8, 086	203, 917	247, 428	269, 462
Butter	30	7, 056		7, 086	7, 241
Lard		8, 437		8, 437	8, 684
Sugar			3, 720	3, 720	3, 718
Yeast	218	16	391	625	738
Total	35, 673	23, 595	208, 028	267, 296	289, 843
Bread baked:					
68 loaves (without sugar)	18, 853	3, 004	106, 040	127, 897	142, 945
81 loaves (with sugar)	16, 769	6, 636	101, 014	124, 419	137, 926
Total	35, 622	9, 640	207, 054	252, 316	280, 871

It was believed that if fats were simply rendered nonextractable by the process of baking, the test with the bomb calorimeter would reveal the fact. In an analysis nonextractable fats would be classed as carbohydrates, which have a much lower fuel value than the fats, and thus the fuel value obtained by calculations based on percentage composition would be proportionately lower than the fuel value obtained by actual determinations with the bomb calorimeter.

The results obtained show a higher fuel value by actual experiment than by calculation, both in the materials and in the bread. They rather verify than disprove the indications that an actual loss of fat occurs in the process of baking, and that the loss is much greater than was formerly supposed. Further experiments are now in progress along these lines.

THE RELATIVE COST OF THE NUTRIENTS IN RAW MATERIALS AND IN BREAD.

The most important human food cereal is wheat. The production of this grain in recent years has been relatively unprofitable, yet it is

claimed that the price of bread to the consumer has not been materially reduced; or, stated in another way, although the profit of production has been reduced, the cost of transformation into bread has been virtually increased.

Because of its practically uniform composition, wheat is a standard product. A given quantity will furnish practically a definite amount of nutriment, and, furthermore, a definite sum of money paid for wheat will purchase practically the same amount of nutriment wherever the wheat may have been produced. This is also true in regard to the same brand of flour made from the wheat. That it is not true of bread made from the flour, although the process of manufacture is practically unvarying, is very fully shown in the previous discussion.

Definite information concerning the transformations that occur in food products between the grower and the consumer, and the relative cost of such transformations is much needed.

A determination of the relative increase in the cost of nutrients in flour and in bread, through the simple process of baking, was included in the bakery studies. The exact weight of the different materials entering into the bread and their full market cost, as well as the weight of the bread made, and its selling price, were carefully recorded for the two experiments, and the results are shown in Table 10.

TABLE 10.—*Cost of raw materials and of bread.*

EXPERIMENT NO. 1.

MATERIALS.

Flour (spring wheat), 80 lbs., at 2 cts	$1.60
Flour (winter wheat), 101 lbs., at 1.75 cts	1.77
Butter, 1.6 lbs., at 18 cts	.29
Lard, 2.5 lbs., at 7.5 cts	.19
Sugar, 2 lbs., at 5 cts	.10
Yeast, 1 lb., at 35 cts	.35
Salt, 2.5 lbs., at 2 cts	.05
Total cost of materials, 190.6 pounds	4.35
Water, 11 gallons.	
Cost per pound of materials, 2.28 cts.	

BREAD.

80 lbs. bread (71 loaves, at 4 cts.)	$2.84
176 lbs. bread (97 loaves, at 8 cts.)	7.76
Value of 256 pounds of bread	10.60
Value of 1 pound of bread, 4.14 cts.	

SUMMARY.

181 pounds of flour = 256 pounds of bread.
100 pounds of flour = 141.5 pounds of bread.

Cost of 100 lbs. of materials, flour, butter, lard, and sugar	$2.28
Value of bread from 100 lbs. of flour	5.86

Experiment No. 2.

MATERIALS.

Flour (spring wheat), 149.75 lbs., at 2.5 cts	$3.07
Butter, 2 lbs., at 18 cts	.36
Lard, 2 lbs., at 7.5 cts	.15
Sugar, 2 lbs., at 5 cts	.10
Yeast, 1 lb., at 35 cts	.35
Salt, 2 lbs., at 2 cts	.04
Total cost of 158.75 lbs. of materials	4.07

Water, 11 gallons.
Cost per pound of materials, 2.6 cts.

BREAD.

80 lbs. bread (70 loaves, at 4 cts.)	$2.80
137 lbs. bread (79 loaves, at 8 cts.)	6.32
Value of 217 pounds of bread	9.12

Value of 1 pound of bread, 4.2 cts.

SUMMARY.

149.75 pounds of flour = 217 pounds of bread.
100 pounds of flour = 144.8 pounds of bread.

Cost of 100 pounds of flour plus butter, lard, and sugar	$2.56
Value of bread from 100 pounds of flour	6.08

The first important point shown by this work is the relation of the weights of bread to the weight of flour used. In experiment No. 1, 100 pounds of flour made 141.5 pounds, and in No. 2, 144.8 pounds, or on an average 143.15 pounds.

In the second place, it is shown that 100 pounds of flour, which costs $1.95, plus the usual amount of other materials added, which cost on the average 49 cents, making a total cost of $2.44, will produce bread sold for $5.97; that is, making the materials into bread has increased the cost $3.53. Stated in another way, the actual nutrients that would cost $1 in the form of flour, lard, butter, yeast, salt, etc., would cost $2.49 if bought in the form of bread; that is, the consumer must pay $1.49 for making materials that cost $1 into bread and for distributing and selling the bread.

It will be observed, too, that the average cost per pound of bread here is practically the same as the average for the whole city of New Brunswick and less than the average for the four cities, and therefore the deductions made are not unfair to other bakers, as the cost of supplies is not widely different in the cities represented. It is true, however, that the flour and other materials used cost less to the baker, who buys at wholesale, than to the individual consumer, who buys in small amounts at retail. The data, however, are worthy of consideration by all consumers.

One bushel of wheat (60 pounds) will make about 44 pounds of flour; one barrel of flour is therefore equivalent to 4.5 bushels of wheat. The producer receives, at 65 cents per bushel, $2.93 for wheat equivalent to one barrel of flour. The baker pays approximately $4 for the flour. The difference, $1.07, or 40 per cent of the first cost, plus about 72

pounds of by-products, viz, bran, middlings, and coarse flour, worth at present prices 54 cents, represents the charges of manufacturing and carriage to the baker. The baker manufactures the flour into bread, adding lard, etc., worth about 96 cents, and the consumer pays $10.74 for the bread produced. The difference, representing the charges of the baker, or the increase in the cost of nutrients between the flour and the bread, is $5.78, or 116.5 per cent. In other words, $100 worth of flour and other raw materials are made into bread which sells for $216.50.

It would seem, therefore, that the increased cost of nutrients, due to the transformations taking place between the producer and consumer, are chargeable in greater measure to the baker than to the miller.

These facts having been derived from actual experiment, it remains for the consumer to determine whether, under his conditions, it will be more economical to purchase the bread or to purchase the flour and other materials and to incur the other expenses necessary in the baking of bread at home.

COMPOSITION AND COST OF MILK IN CITIES IN NEW JERSEY.

COMPOSITION.

The purpose of this investigation was to obtain definite information concerning the cost of milk to consumers, the variations in composition or quality, and the relative cost of the nutrients furnished in milk in a number of cities in New Jersey.

Sampling.—The samples represent as nearly as possible the milk actually supplied in the various cities. Samples were not taken from every dealer, but the number taken represents a fair proportion of both small and large producers and dealers. In every case the samples were taken in the morning from the delivery wagons on their routes and from the stores of retailers. They represent, therefore, milk as delivered to consumers. Some samples were taken from full cans, some from cans partially full, and some from cans almost empty. In the case of bottled milk the entire contents of one bottle was taken as a sample.

In sampling milk by dipping from the can, it has been claimed that abnormal variations are quite likely to occur because the cream rises, and unless the milk is thoroughly stirred after each dipping an undue proportion of fat would be contained in the samples first taken out. In other words, the samples first removed would show a higher content of fat, and the last ones a lower content of fat than the normal milk.

Experiments conducted at the Cornell Experiment Station[1] apparently disprove this claim, and the normal character of the majority of the samples of milk examined in the present investigation seems to verify the results secured there.

Where milk is put up in bottles, particularly if the modern bottling

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[1] New York Cornell Sta. Bul. 20.

arrangements are used, variations in the composition of different samples of the same lot are not likely to occur.

The analyses of the samples were made immediately upon their receipt in the laboratory by the chemical methods adopted by the Association of Official Agricultural Chemists.

The composition of the various samples of milk is shown in the following table:

TABLE 11.—*Composition of samples of milk.*

FROM NEW BRUNSWICK.

Sample number.	Date of sampling.	Price per quart.	Total solids.	Fat.	Casein and albumen.	Sugar.	Ash.
		Cents.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
1	Jan. 30	8	13.55	3.94	3.74	5.09	0.78
2	....do ...	8	13.00	4.46	3.22	4.57	.75
3	....do ...	8	13.12	4.03	3.31	5.04	.74
4	....do ...	8	13.37	4.44	3.51	4.66	.76
5	....do ...	8	11.83	3.62	2.94	4.56	.71
6	....do ...	8	13.71	4.39	3.47	5.11	.74
7	Feb. 3	8	11.92	3.20	3.24	4.75	.73
8	....do ...	8	13.46	4.43	3.12	5.20	.71
9	....do ...	8	13.28	4.21	3.36	4.97	.74
10	....do ...	8	12.72	3.57	3.48	4.94	.73
11	....do ...	8	13.37	4.26	3.32	5.07	.72
12	....do ...	8	12.55	3.56	3.23	5.04	.72
13	....do ...	6	11.85	3.21	3.21	4.70	.73
14	....do ...	8	14.03	4.54	3.73	4.99	.77
15	....do ...	6	11.82	2.99	3.23	4.88	.72
16	....do ...	8	12.62	3.73	3.20	4.97	.72
17	....do ...	8	12.51	3.79	3.22	4.78	.72
18	....do ...	8	12.48	3.35	3.39	4.93	.81
19	....do ...	8	12.11	3.37	3.22	4.73	.79
20	....do ...	8	12.98	3.85	3.47	4.93	.73
21	....do ...	8	12.53	3.54	3.41	4.83	.75
22	....do ...	8	12.73	4.01	3.46	4.55	.71
23	....do ...	8	12.20	3.38	3.13	4.97	.72
24	....do ...	8	11.88	3.91	3.16	4.18	.63
25	....do ...	8	13.04	3.97	3.49	4.85	.73
27	Mar. 20	8	14.02	4.57	3.70	4.98	.77
Average	....	....	12.83	3.86	3.34	4.86	.74

FROM NEWARK.

Sample number.	Date of sampling.	Price per quart.	Total solids.	Fat.	Casein and albumen.	Sugar.	Ash.
31	Feb. 11	8	13.44	4.41	3.64	4.66	0.73
32	....do ...	8	11.70	3.92	3.09	4.06	.63
33	....do ...	8	12.88	4.07	3.50	4.57	.74
34	....do ...	8	12.83	3.80	3.69	4.57	.77
35	....do ...	8	13.36	4.17	3.60	4.85	.74
36	....do ...	8	13.00	3.99	3.53	4.77	.71
37	....do ...	8	13.15	3.88	3.56	5.00	.71
38	....do ...	8	13.51	4.31	3.51	4.96	.73
39	....do ...	8	12.86	3.98	3.58	4.57	.73
40	....do ...	8	12.91	4.00	3.42	4.79	.70
41	....do ...	8	13.30	4.32	3.41	4.84	.73
42	....do ...	8	11.85	3.36	2.99	4.83	.67
43	....do ...	8	12.61	3.58	3.59	4.71	.73
44	....do ...	8	12.30	3.62	3.33	4.66	.69
45	....do ...	8	13.64	4.69	3.56	4.68	.71
46	....do ...	8	14.51	4.98	4.06	4.74	.73
47	....do ...	8	13.08	4.09	3.33	4.95	.71
48	....do ...	8	12.72	3.81	3.54	4.62	.75
49	....do ...	8	13.69	4.80	3.31	4.90	.68
50	....do ...	8	12.11	3.47	3.38	4.60	.66
51	....do ...	8	12.65	3.81	3.45	4.69	.70
52	....do ...	8	12.89	3.85	3.36	4.99	.69
53	....do ...	8	12.25	3.52	3.45	4.57	.71
54	....do ...	6	11.35	2.85	3.16	4.62	.72
55	....do ...	6	11.89	3.36	3.08	4.76	.69
56	....do ...	6	14.07	4.54	3.99	4.80	.74
57	....do ...	6	10.81	2.56	2.99	4.63	.63
58	....do ...	6	11.93	3.29	3.46	4.46	.72
59	....do ...	6	14.86	6.92	3.09	4.17	.68
60	....do ...	6	12.89	4.28	3.11	4.81	.69
Average	....	....	12.83	4.01	3.43	4.69	.71

TABLE 11.—*Composition of samples of milk*—Continued.

FROM TRENTON.

Sample number.	Date of sampling.	Price per quart.	Total solids.	Fat.	Casein and albumen.	Sugar.	Ash.
		Cents.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
61	Feb. 28	8	12.30	3.50	3.41	4.66	0.73
62	....do ...	8	13.00	4.30	3.26	4.73	.71
63	....do ...	8	12.11	3.30	3.43	4.66	.72
64	....do ...	8	12.44	3.47	3.56	4.70	.71
65	....do ...	8	13.96	4.80	3.56	4.89	.71
66	....do ...	8	13.66	4.80	3.20	4.94	.72
67	....do ...	8	12.56	3.97	3.11	4.78	.70
68	....do ...	8	12.14	3.85	3.06	4.58	.65
69	....do ...	6	13.26	4.26	3.44	4.86	.70
70	....do ...	8	13.13	4.13	3.36	4.91	.73
71	....do ...	8	12.49	3.31	3.26	5.18	.74
72	....do ...	8	12.93	3.81	3.63	4.73	.76
73	....do ...	8	11.62	3.71	3.19	4.07	.65
74	....do ...	8	12.42	3.68	3.24	4.75	.75
75	....do ...	8	12.54	3.83	3.04	4.93	.74
76	....do ...	8	12.03	3.25	3.20	4.91	.67
77	....do ...	8	12.23	3.81	3.36	4.36	.70
78	....do ...	8	12.07	3.66	3.03	4.67	.71
79	....do ...	8	12.56	3.31	3.81	4.67	.77
80	....do ...	8	13.00	3.82	3.68	4.72	.78
81	....do ...	8	12.79	4.03	3.46	4.62	.68
82	....do ...	8	13.35	3.89	4.01	4.70	.75
83	....do ...	8	13.14	4.02	3.67	4.75	.70
84	....do ...	8	10.64	2.97	2.68	4.37	.62
Average	....	....	12.60	3.81	3.35	4.71	.71

FROM CAMDEN.

Sample number.	Date of sampling.	Price per quart.	Total solids.	Fat.	Casein and albumen.	Sugar.	Ash.
85	Mar. 9	8	12.81	4.37	3.38	4.38	0.68
86	....do ...	8	12.17	3.28	3.15	5.05	.69
87	....do ...	8	12.51	4.12	3.41	4.29	.69
88	....do ...	8	12.66	4.12	3.22	4.61	.71
89	....do ...	8	12.06	4.51	2.69	4.25	.61
90	....do ...	8	12.04	3.53	3.12	4.71	.68
92	....do ...	8	14.58	5.35	3.71	4.81	.71
93	....do ...	8	14.16	5.26	3.49	4.73	.68
94	....do ...	8	12.71	4.21	3.13	4.70	.67
95	....do ...	8	14.18	5.28	3.43	4.83	.64
96	....do ...	8	14.89	6.49	3.12	4.62	.66
97	....do ...	8	13.70	4.61	3.66	4.74	.69
98	....do ...	8	13.54	4.66	3.49	4.67	.72
99	....do ...	8	14.72	5.74	3.61	4.65	.72
100	....do ...	8	12.51	3.90	3.12	4.80	.69
101	....do ...	8	13.06	4.18	3.25	4.92	.71
103	....do ...	8	13.41	4.55	3.41	4.71	.74
104	....do ...	8	13.78	4.86	3.32	4.89	.71
105	....do ...	8	13.81	4.46	3.58	5.04	.73
106	....do ...	8	14.95	5.59	3.68	4.92	.76
107	....do ...	8	16.55	7.76	3.21	4.92	.66
108	....do ...	8	14.65	5.37	3.53	5.01	.74
Average	....	....	13.62	4.83	3.35	4.74	.70
Average of all	....	....	12.97	4.13	3.37	4.75	.72

COST PER QUART.

The cost of milk as delivered to consumers was practically the same everywhere, namely, 8 cents per quart. It should be stated, however, that this price does not rule throughout the year in all the cities represented. In New Brunswick the price is 6 cents per quart from May 1 to November 1, making the average for the year 7 cents per quart. In one or two instances where a producer or dealer was trying to build up a trade there were variations from the usual price. In the case of samples Nos. 54 to 60, inclusive, the price was 6 cents per quart at the

dealer's store; the milk was not delivered at the homes of consumers. The variation in cost of the nutrients furnished was, therefore, due almost entirely to the differences in the quality of the milk.

VARIATIONS IN THE COMPOSITION OR QUALITY OF MILK DUE TO NATURAL CAUSES.

Milk is not a product of fixed composition. Both the total amount and the proportions of the constituents contained in it are influenced by a variety of conditions, the chief of which is, perhaps, the individuality of the cow. Breed, food, age, health, period of lactation, and time and season of milking are also determining factors.

Of the constituents of the dry matter of milk, viz, butter-fat, proteids (chiefly casein and albumen), sugar, and mineral salts, fat seems to vary more than the others, though each may vary considerably. Normal milk may be said to contain on the average the following amounts and proportions of the different constituents:

	Per cent.
Water	87.50
Total solids	12.50
Butter fat	3.50
Casein and albumen	3.75
Milk sugar	4.50
Ash (mineral salts)	.75

This average composition has served as the basis in both State and city governments for the enactment of laws or ordinances, the purpose of which is to prevent watering, skimming, and other forms of adulteration. The standards adopted seldom require more than 12.5 per cent total solids and 3 per cent of fat. Thus what may be regarded as the average quality of milk usually exceeds the limit fixed by the various laws, particularly in fat content.

Normal, or whole milk, will, however, show wide variations in both directions from this standard; that is, it may be very much richer or very much poorer.

The influence of breed is also very marked, so much so that dairy breeds are classified into milk and butter breeds; that is, those which give a larger quantity of poorer quality, and those which give a smaller quantity of a higher quality. The milk from animals which naturally produce large quantities shows average quality, and that from animals which produce a smaller quantity shows a quality considerably above the average. That the content of fat in milk varies more than the other constituents, is also distinctly shown in the investigations of milk from different cities here reported.

The food is an important factor affecting the quality of milk, not always appreciated. A specific breed possesses certain capabilities, the values of which are dependent in large measure upon the food that is supplied. Owing to the inherent tendency of the animal to produce milk of a definite composition, food may not exercise a positive and immediate influence in improving the quality of the milk; still, a cow

can not reach her normal capacity in this respect unless she is supplied with sufficient food.

The age and health of the animal also affect the composition of milk. Young animals produce richer milk than older ones, though much depends upon health, vitality, and vigor. The period of lactation, that is, the length of time which has elapsed since the birth of the calf, also exercises an influence upon the composition of the milk. The milk flow is usually greatest, and the milk poorest, soon after calving; as the period increases the flow gradually falls off, and as a rule the quality improves. However, the influence of all these factors is not so marked in mixed milk as in the milk of individual animals.

DISCUSSION OF RESULTS OF ANALYSES.

In the samples obtained from New Brunswick, the variation in total solids ranges from 11.82 to 14.03 per cent, a difference of 2.21 per cent. The variation in fat ranges from 2.99 to 4.57 per cent, a difference of 1.58 per cent. The average composition of the milk, however, is higher than the commonly accepted average composition of normal milk. In but one case is the variation in composition so marked as to indicate that the samples were not fairly representative of whole milk.

In the samples taken from Newark, the total solids range from 10.81 to 14.86 per cent, a difference of 4.05 per cent; while the fat ranges from 2.56 per cent to 6.92 per cent, a difference of 4.36 per cent. The average composition is, so far as total solids are concerned, practically identical with the New Brunswick average, though showing a slightly higher percentage of fat. In one sample, No. 57, the content of total solids and fat is so low as to create a suspicion of adulteration. Another sample, No. 59, contains an undue proportion of fat.

In the samples from Trenton, the percentage of total solids ranges from 10.64 to 13.96 per cent, a difference of 3.32 per cent. The fat ranges from 2.97 to 4.80 per cent, a difference of 1.83 per cent. In one sample only, No. 84, does there appear to be an abnormally low content of total solids and fat.

In the samples from Camden, the range in total solids is from 12.06 to 16.55 per cent, a difference of 4.49 per cent. The range in fat is from 3.28 to 7.76 per cent, a difference of 4.48 per cent. The average composition of the milk of Camden is very much higher than that from other cities, both in total solids and in fat. Only two samples, Nos. 89 and 107, show an abnormal percentage of fat.

On the whole, the milk supplies of these cities may be regarded as extremely good, the average composition being: Total solids 12.97, fat 4.13, casein and albumen 3.37, sugar 4.75, and ash 0.72 per cent.

SOURCES OF SUPPLY.

In New Brunswick and Trenton, the milk supply is derived almost entirely from local producers, who deliver the milk themselves. In

Newark and Camden it is derived both from local producers and from large dealers, who procure their supplies from more distant points. In Newark very considerable quantities are shipped from Sussex and Warren counties in New Jersey, and neighboring sections of New York and Pennsylvania. In Camden a large portion of the supply comes from the more southern sections of New Jersey.

Some inquiry was made in reference to the animals in the different dairies. It appears that the majority of the dairies contained animals of the Channel Island breeds, while a few contained pure-bred Jerseys, Guernseys, Holstein-Friesians, and Ayrshires.

VARIATIONS IN THE FAT CONTENT OF THE SAMPLES OF MILK.

In the following tables the samples have been arranged in eight classes: (1) Those containing less than 3 per cent of fat; (2) those containing from 3 to 3.50 per cent; (3) those from 3.50 to 4 per cent; (4) those from 4 to 4.50 per cent; (5) those from 4.50 to 5 per cent; (6) those from 5 to 5.50 per cent; (7) those from 5.50 to 6; and, (8) those containing over 6 per cent of fat:

TABLE 12.—*Classification of samples on the basis of their fat content.*

CLASS 1.—LESS THAN 3 PER CENT FAT.

Sample number.	Total solids.	Fat.	Solids, not-fat.	Casein and albumen.	Sugar.	Ash.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
15	11.82	2.99	8.83	3.23	4.88	0.72
54	11.35	2.85	8.50	3.16	4.62	.72
57	10.81	2.56	8.25	2.99	4.63	.63
84	10.64	2.97	7.67	2.68	4.37	.62
Average	11.16	2.84	8.31	3.02	4.63	.67

CLASS 2.—FROM 3 TO 3.5 PER CENT FAT.

Sample number.	Total solids.	Fat.	Solids, not-fat.	Casein and albumen.	Sugar.	Ash.
7	11.92	3.20	8.72	3.24	4.75	0.73
13	11.85	3.21	8.64	3.21	4.70	.73
18	12.48	3.35	9.13	3.39	4.93	.81
19	12.11	3.37	8.74	3.22	4.73	.79
23	12.20	3.38	8.82	3.13	4.97	.72
42	11.85	3.36	8.49	2.99	4.83	.67
50	12.11	3.47	8.64	3.38	4.60	.66
55	11.89	3.36	8.53	3.08	4.76	.69
58	11.93	3.29	8.64	3.46	4.46	.72
61	12.30	3.50	8.80	3.41	4.66	.73
63	12.11	3.30	8.81	3.43	4.66	.72
64	12.44	3.47	8.97	3.56	4.70	.71
71	12.49	3.31	9.18	3.26	5.18	.74
76	12.03	3.25	8.78	3.20	4.91	.67
79	12.56	3.31	9.25	3.81	4.67	.77
86	12.17	3.28	8.89	3.15	5.05	.69
Average	12.15	3.34	8.81	3.31	4.79	.72

TABLE 12.—*Classification of samples on the basis of their fat content*—Continued.

CLASS 3.—FROM 3.5 TO 4 PER CENT FAT.

Sample number.	Total solids.	Fat.	Solids, not-fat.	Casein and albumen.	Sugar.	Ash.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
1	13.55	3.94	9.61	3.74	5.09	0.78
5	11.83	3.62	8.21	2.94	4.56	.71
10	12.72	3.57	9.15	3.48	4.94	.73
12	12.55	3.56	8.99	3.23	5.04	.72
16	12.62	3.73	8.89	3.20	4.97	.72
17	12.51	3.79	8.72	3.22	4.78	.72
20	12.98	3.85	9.13	3.47	4.93	.73
21	12.53	3.54	8.99	3.41	4.83	.75
24	11.88	3.91	7.97	3.16	4.18	.63
25	13.04	3.97	9.07	3.49	4.85	.73
32	11.70	3.92	7.78	3.09	4.06	.63
34	12.83	3.80	9.03	3.69	4.57	.77
36	13.00	3.99	9.01	3.53	4.77	.71
37	13.15	3.88	9.27	3.56	5.00	.71
39	12.86	3.98	8.88	3.58	4.57	.73
40	12.91	4.00	8.91	3.42	4.79	.70
43	12.61	3.58	9.03	3.59	4.71	.73
44	12.30	3.62	8.68	3.33	4.66	.69
48	12.72	3.81	8.91	3.54	4.62	.75
51	12.65	3.81	8.84	3.45	4.69	.70
52	12.89	3.85	9.04	3.36	4.99	.69
53	12.25	3.52	8.73	3.45	4.57	.71
67	12.56	3.97	8.59	3.11	4.78	.70
68	12.14	3.85	8.29	3.06	4.58	.65
72	12.93	3.81	9.12	3.63	4.73	.76
73	11.62	3.71	7.91	3.19	4.07	.65
74	12.42	3.68	8.74	3.24	4.75	.75
75	12.54	3.83	8.71	3.04	4.93	.74
77	12.23	3.81	8.42	3.36	4.36	.70
78	12.07	3.66	8.41	3.03	4.67	.71
80	13.00	3.82	9.18	3.68	4.72	.78
82	13.35	3.89	9.46	4.01	4.70	.75
90	12.04	3.53	8.51	3.12	4.71	.68
100	12.51	3.90	8.61	3.12	4.80	.69
Average	12.57	3.79	8.79	3.37	4.35	.71

CLASS 4.—FROM 4 TO 4.5 PER CENT FAT.

2	13.00	4.46	8.54	3.22	4.57	0.75
3	13.12	4.03	9.09	3.31	5.04	.74
4	13.37	4.44	8.93	3.51	4.66	.76
6	13.71	4.39	9.32	3.47	5.11	.74
9	13.46	4.43	9.03	3.12	5.20	.71
8	13.28	4.21	9.07	3.36	4.97	.74
11	13.37	4.26	9.11	3.32	5.07	.72
22	12.73	4.01	8.72	3.46	4.55	.71
31	13.44	4.41	9.03	3.64	4.66	.73
33	12.88	4.07	8.81	3.50	4.57	.74
35	13.36	4.17	9.19	3.60	4.85	.74
38	13.51	4.31	9.20	3.51	4.96	.73
41	13.30	4.32	8.98	3.41	4.84	.73
47	13.08	4.09	8.99	3.33	4.95	.73
60	12.89	4.28	8.61	3.11	4.81	.69
62	13.00	4.30	8.70	3.26	4.73	.71
69	13.26	4.26	9.00	3.44	4.86	.70
70	13.13	4.13	9.00	3.36	4.91	.73
81	12.79	4.03	8.76	3.46	4.62	.68
83	13.14	4.02	9.12	3.67	4.75	.70
85	12.81	4.37	8.44	3.38	4.38	.68
87	12.51	4.12	8.39	3.41	4.29	.69
88	12.66	4.12	8.54	3.22	4.61	.71
94	12.71	4.21	8.50	3.13	4.70	.67
101	13.06	4.18	8.88	3.25	4.92	.71
105	13.81	4.46	9.35	3.58	5.04	.73
Average	13.13	4.23	8.90	3.39	4.33	.72

TABLE 12.—*Classification of samples on the basis of their fat content*—Continued.

CLASS 5.—FROM 4.5 TO 5 PER CENT FAT.

Sample number.	Total solids.	Fat.	Solids, not-fat.	Casein and albumen.	Sugar.	Ash.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
14	14.03	4.54	9.49	3.73	4.99	0.77
27	14.02	4.57	9.45	3.70	4.98	.77
45	13.64	4.69	8.95	3.56	4.68	.71
46	14.51	4.98	9.53	4.06	4.74	.73
49	13.69	4.80	8.89	3.31	4.90	.68
56	14.07	4.54	9.53	3.99	4.80	.74
65	13.96	4.80	9.16	3.56	4.89	.71
66	13.66	4.80	8.86	3.20	4.94	.72
89	12.06	4.51	7.55	2.69	4.25	.61
97	13.70	4.61	9.09	3.66	4.74	.69
98	13.54	4.66	8.88	3.49	4.67	.72
103	13.41	4.55	8.86	3.41	4.71	.74
104	13.78	4.86	8.92	3.32	4.89	.71
Average	13.70	4.69	9.01	3.51	4.78	.72

CLASS 6.—FROM 5 TO 5.5 PER CENT FAT.

Sample number.	Total solids.	Fat.	Solids, not-fat.	Casein and albumen.	Sugar.	Ash.
92	14.58	5.35	9.23	3.71	4.81	0.71
93	14.16	5.26	8.90	3.49	4.73	.68
95	14.18	5.28	8.90	3.43	4.83	.64
108	14.65	5.37	9.28	3.53	5.01	.74
Average	14.39	5.32	9.08	3.54	4.84	.69

CLASS 7.—FROM 5.5 TO 6 PER CENT FAT.

Sample number.	Total solids.	Fat.	Solids, not-fat.	Casein and albumen.	Sugar.	Ash.
99	14.72	5.74	8.98	3.61	4.65	0.72
106	14.95	5.59	9.36	3.68	4.92	.76
Average	14.84	5.67	9.17	3.65	4.79	.74

CLASS 8.—OVER 6 PER CENT FAT.

Sample number.	Total solids.	Fat.	Solids, not-fat.	Casein and albumen.	Sugar.	Ash.
59	14.86	6.92	7.94	3.09	4.17	0.68
96	14.89	6.49	8.40	3.12	4.62	.66
107	16.55	7.76	8.79	3.21	4.92	.66
Average	15.43	7.06	8.38	3.14	4.57	.67

In the preceding table the percentages of solids-not-fat as well as those of fat are shown, since they seem to have a bearing upon the discussion of the nutritive value of the various classes of milk.

In class 1 but four samples are recorded in which the total solids average less than 12 per cent and the fat 2.84 per cent. So low an average composition would seem to indicate that the samples included do not represent the whole milk of well-fed, healthy animals. These milks were sold at the same price per quart as others of higher quality and are therefore included in this discussion.

Class 2 includes 16 samples showing an average of 12.15 per cent total solids and 3.34 per cent fat.

Class 3 includes 34 samples or one third of the whole number. The average composition of these exceeds the average assumed for good milk. Of the 48 remaining samples, nearly half exceed 13 per cent total solids and 4 per cent fat.

CHARACTER OF THE ANIMALS AND RATIONS FED.

In many cases it was possible to learn the breed of animals kept and the rations fed in the dairies furnishing the samples included in Table 12. In class 1, 3 of the 4 samples were the milk of "common stock" (animals of no distinctive breeding or grading, sometimes called "scrub stock"). The rations fed in two of the four cases reported were manifestly insufficient to properly nourish cows in the full flow of milk.

Common stock was reported by 11 of the 16 dairies furnishing the samples included in class 2. In one case only pure-bred animals, Jerseys, were kept, and in four cases grade Jerseys and Holsteins were kept. In seven cases it was possible to secure information concerning rations fed, and only two of these could be regarded as good.

Data were secured from 26 of the 34 dairies furnishing the samples included in class 3, and of these 11 reported Jersey or Guernsey grades, the remainder common stock. The rations fed in seven cases were regarded as fairly good.

It was possible to secure data from 20 of the 26 dairies furnishing the samples included in class 4. Nine of these reported Jerseys and three pure-bred Jerseys, the remainder common stock. In only four cases were the rations given and all were good.

Data were secured from 12 of the 13 dairies furnishing the samples included in class 5. Seven report high-grade Jerseys or Guernseys. In three cases only was it possible to secure definite information concerning rations, all of which were good.

Of the 4 dairies furnishing the samples included in class 6, 3 report Jersey grades. Liberal and well-proportioned rations were fed in every case. The samples in class 7 were produced by pure-bred Jerseys and Guernseys, and the rations fed were well adapted for milk production. One of the samples included in class 8 was from pure-bred Jerseys, one from grade Jerseys, and one from pure-bred Guernseys. No report of rations is given.

It will be observed from these data that with the improvement of the stock by the introduction of recognized butter-producing breeds of cows the quality of the product also materially improved. In class 1 all were common stock; in class 2, 30 per cent of the dairies contained improved dairy stock; in class 3, the proportion of improved stock is increased to over 40 per cent; in class 4, to 60 per cent; in class 5, it is practically the same, while in classes 6, 7, and 8 the entire number of dairies reported either pure-bred or high-grade dairy stock. In other words, the quality of the milk delivered to consumers is very materially influenced by the character of the stock kept.

While the facts obtained in the matter of rations are interesting and in line with what was to be expected, the data are too incomplete to warrant general conclusions.

THE RELATIVE COST PER POUND OF NUTRIENTS IN MILK.

The fact that in respect to composition milk falls into the various classes indicated shows that at a uniform price per quart there is a

wide variation in the cost of the nutrients to the consumer. Assuming that the quality of the nutrients as represented by the total solids is quite as good in one class of samples as in another, the cost per pound of total solids in class 1 at the rate of 8 cents per quart, or 2 cents per pound,[1] is 35 cents, while in class 8 it is 26 cents. That is, it is 38.5 per cent greater in class 1 than in class 8. In other words, $100 spent for milk of the quality represented by class 8 would purchase the same amount of nutrients as $138.50 expended for milk of the quality represented by class 1.

These extremes exhibit the range of cost per pound of total solids. The average cost would be 31 cents. Class 4, which includes about one-fourth of the total number of samples, furnishes total solids at about this price. More than one-half of the total number of samples, however, shows a lower quality than the average.

THE QUALITY OF THE TOTAL SOLIDS IN MILK.

Fat contains about two and one quarter times as many heat units or calories per pound as protein or carbohydrates; hence, so far as supplying heat to the body is concerned, a pound of fat is two and one quarter times as valuable as a pound of protein or carbohydrates.

It will be observed from study of the average composition of the milks in the preceding classification that, with the increase in the total solids in milk, the percentage of fat is increased in greater proportion than the solids not fat. For instance, in class 1, only 25.9 per cent of the total solids is fat; in class 2, with slightly over 12 per cent total solids, it is increased to 27.5 per cent; in class 3, with over 12.50 per cent total solids, the fat constitutes 30.2 per cent of the total nutrients; in class 4, with over 13 per cent total solids, the fat is increased to 32.2 per cent; in class 5, with 13.70 per cent total solids, the fat constitutes 34.2 per cent of the total nutrients; in class 6, it is 37.20 per cent; in class 7, 38.2 per cent, and in class 8, 45.8 per cent of the total solids contained in the milk.

In other words, the total solids of class 6, for instance, contains 20 pounds per hundred more of fat than the total solids of class 1. The consumer not only secures total solids in the richer milk at a lower cost per pound, but also obtains total solids which are very much richer in fuel value.

The facts brought out by this investigation in regard to the variation in the cost and quality of the nutrients contained in milk show very clearly that the standard now in use as the basis of sale, viz, the quart, is illogical, and is unfair both to the consumer and to the producer of good milk.

Assuming that the percentage of fat is a safe guide to the nutritive value of milk—an assumption practically borne out by this study—the content of this constituent would furnish a better standard than the quart. For instance, the average of all the milks examined, which at

[1] On the average a quart of milk will weigh 2.15 pounds.

the average price of 8 cents per quart cost $4 per hundred, contained in round numbers 4 per cent, or 4 pounds, per hundred of fat. If milk containing 4 per cent of fat is worth 8 cents per quart, milk containing 3.50 per cent would, on the same basis, be worth 7 cents per quart; and milk containing 3 per cent only 6 cents per quart. On the other hand, milk containing 4.50 per cent of fat would be worth 9 cents per quart, and that containing 5 per cent of fat, 10 cents per quart.

If the fat-content standard were adopted the consumer would be protected in the sense that he would receive just what he paid for, and the producer of a high quality product would receive the advantage of a higher price, which fairly belongs to him, because of the greater cost of producing milk of a better quality.

This method of purchasing milk by actual composition is now used in many creameries with entire satisfaction to both the seller and the buyer. The facts brought out in this investigation indicate that its adoption is quite as important in the purchase of supplies for the home. It is entirely practicable, too, under present conditions, for even the smaller producers and dealers to guarantee a product containing a reasonably definite content of fat, because the chief causes of variations in the quality of milk under improved methods of feeding and management are well known, and inexpensive instruments which are simple in operation are available for testing the fat content of milk. It remains for the more intelligent consumers and producers to demand that the system be adopted.

THE DIETARY STUDY.

The plan of this investigation was essentially the same as that described in previous publications of this Office.[1] Exact account was taken of all the food materials in the house (1) at the beginning of the study, (2) purchased during its progress, and (3) remaining at the end. The difference between 3 and the sum of 1 and 2 was taken as the amount consumed. From the figures thus obtained and the analyses of the different materials, the amounts of the different nutrients supplied in the diet were calculated. Deducting from these the weights of the nutrients found in the table and kitchen waste the amounts actually consumed were obtained. Accounts were also kept of the meals taken by the different members of the family and by visitors.[2]

The results of the analyses of (1) materials as purchased, (2) fresh, edible portion, and (3) water-free edible portion are shown in Tables 13, 14, and 15. The methods used for analysis were the same as those employed by Atwater and associates in the analysis of foods.[3]

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[1] U. S. Dept. Agr., Office of Experiment Stations Bul. 21.

[2] The chemical work necessitated by these investigations was largely performed by Messrs. Louis A. Voorhees and John P. Street, chemists of the station, and the preparation of the records in the dietary study and bakery experiments was performed by Mr. H. A. Torrey, of Middletown, Conn.

[3] Described in Connecticut Storrs Station Report for 1891 and briefly stated in Bulletin 29 of this Office.

TABLE 13.—*Composition of food materials as purchased, including both edible portion and refuse.*[1]

Kind of food material.	Reference number.	Refuse.	Water.	Protein.[2]	Fat.	Carbohydrates.	Ash.	Fuel value per pound.
ANIMAL FOOD.								
Beef:		*Per cent.*	*Per cent.*	*Per cent.*	*Per ct.*	*Per cent.*	*Per ct.*	*Calories.*
Chuck steak	19	10.5	60.0	16.3	12.4	....	0.8	825
Loin	82	5.1	55.1	16.9	21.9	....	1.0	1,240
Sirloin	83	6.1	55.8	19.0	18.1	....	1.0	1,115
Do	84	12.1	52.8	16.4	17.8	....	.9	1,055
Do	85	4.1	54.2	17.9	22.7	....	1.1	1,290
Average	....	7.5	54.2	17.8	19.5	....	1.0	1,155
Rump roast	262	9.0	56.5	17.5	16.1	....	.9	1,005
Do	270	12.4	47.6	15.3	23.9	....	.8	1,295
Average	....	10.7	52.0	16.4	20.0	....	.9	1,150
Mutton: Leg	1550	9.8	55.7	17.1	16.5	....	.9	1,015
Pork:								
Roast	2024	21.8	36.5	10.7	30.4	....	.6	1,480
Steak	2139	14.7	25.9	6.8	52.2	....	.4	2,330
Head cheese	2010	....	43.8	19.4	33.4	....	3.4	1,770
Sausage	2527	....	32.3	8.8	56.8	....	2.1	2,560
Do	2528	....	40.5	12.1	45.0	....	2.4	2,125
Do	2530	....	46.2	17.9	32.5	....	3.4	1,705
Average	....	....	39.7	12.9	44.8	....	2.6	2,130
Poultry: Goose	2709	26.7	27.8	7.2	37.8	....	.5	1,730
Butter	....	....	10.4	1.3	84.0	....	4.3	3,570
Milk	....	....	84.7	4.5	5.9	4.1	.8	410
Do	....	....	85.0	4.0	4.9	5.3	.8	380
Do	....	....	84.8	4.2	5.4	4.8	.8	395
Average	....	....	84.8	4.2	5.4	4.8	.8	395
VEGETABLE FOOD.								
Flour, wheat	5253	....	12.5	11.0	1.0	75.1	.4	1,645
Flour, Hecker's prepared	5284	....	11.4	9.0	1.4	73.3	4.9	1,590
Bread, white, Leppert's	5335	....	35.5	9.2	1.8	52.5	1.0	1,225
Sugar, granulated	....	....	.1	....	....	99.9	....	1,860
Cocoanut, shredded	8097	....	2.8	6.0	51.0	39.0	1.2	2,990
Beans, lima, dried	6516	....	12.2	12.8	1.9	69.5	3.6	1,610
Celery	6564	....	94.4	1.4	.1	3.0	1.1	85
Peas, dried	6594	....	12.1	23.9	1.3	60.1	2.6	1,615
Succotash, canned	7096	....	73.6	4.4	1.2	20.1	.7	505
Prunes, dried	8076	....	....	....	....	....	....	1,340

[1] Analyzed at the New Jersey State Agricultural Experiment Station.
[2] Protein in all animal foods except milk was found by subtracting the sum of fat and ash from 100. In milk and vegetable foods, nitrogen × 6.25 = protein.

TABLE 14.—*Composition of fresh, edible portion of food materials.*[1]

Kind of food material.	Reference number.	Water.	Protein.[2]	Fat.	Carbohydrates.	Ash.	Fuel value per pound.
ANIMAL FOOD.							
Beef:		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Calories.*
Chuck steak	19	67.0	18.2	13.9	....	0.9	925
Loin	82	58.1	17.8	23.1	....	1.0	1,305
Sirloin	83	59.4	20.2	19.3	....	1.1	1,190
Do	84	60.1	18.7	20.2	....	1.0	1,200
Do	85	56.5	18.7	23.7	....	1.1	1,350
Average	....	58.6	19.2	21.1	....	1.1	1,245
Rump roast	262	62.1	19.2	17.7	....	1.0	1,105
Do	270	54.3	17.5	27.3	....	.9	1,480
Average	....	58.2	18.4	22.5	....	.9	1,290
Mutton: Leg	1550	61.7	19.0	18.3	....	1.0	1,125

[1] Analyzed at the New Jersey State Agricultural Experiment Station.
[2] Protein in all animal foods except milk was obtained by subtracting the sum of the refuse, water, fat, and ash from 100. In milk and all vegetable foods, nitrogen × 6.25 = protein.

TABLE 14.—*Composition of fresh, edible portion of food materials*[1]—Continued.

Kind of food material.	Reference number.	Water.	Protein.[2]	Fat.	Carbohydrates.	Ash.	Fuel value per pound.
ANIMAL FOOD—continued.							
Pork:		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Calories.*
Roast	2024	46.7	13.7	38.8	....	.8	1,890
Steak	2139	30.4	8.0	61.1	....	.5	2,725
Head cheese	2010	43.8	19.4	33.4	....	3.4	1,770
Sausage	2527	32.3	8.8	56.8	....	2.1	2,560
Do	2528	40.5	12.1	45.0	....	2.4	2,125
Do	2530	46.2	17.9	32.5	....	3.4	1,705
Average	....	39.7	12.9	44.8	....	2.6	2,130
Poultry: Goose	2709	37.9	9.8	51.6	....	.7	2,360
Butter	....	10.4	1.3	84.0	....	4.3	3,570
Milk	....	84.7	4.5	5.9	4.1	.8	410
Do	....	85.0	4.0	4.9	5.3	.8	380
Do	....	84.8	4.2	5.4	4.8	.8	395
Average	....	84.8	4.2	5.4	4.8	.8	395
VEGETABLE FOOD.							
Flour, wheat	5253	12.5	11.0	1.0	75.1	.4	1,645
Flour, Hecker's prepared	5284	11.4	9.0	1.4	73.3	4.9	1,590
Bread, white, Leppert's	5335	35.5	9.2	1.8	52.5	1.0	1,225
Sugar, granulated	....	.1	....	....	99.9	....	1,860
Cocoanut, shredded	8097	2.8	6.0	51.0	39.0	1.2	2,930
Beans, lima, dried	6516	12.2	12.8	1.9	69.5	3.6	1,610
Celery	6564	94.4	1.4	.1	3.0	1.1	85
Peas, dried	6594	12.1	23.9	1.3	60.1	2.6	1,615
Succotash, canned	7096	73.6	4.4	1.2	20.1	.7	505
Prunes, dried	8076	27.5	2 1	.8	68.1	1.5	1,340

[1]Analyzed at the New Jersey State Agricultural Experiment Station.
[2]Protein in all animal foods except milk was obtained by subtracting the sum of the refuse, water, fat, and ash from 100. In milk and all vegetable foods, nitrogen × 6.25 = protein.

TABLE 15.—*Composition of water-free substance of edible portion of food materials.*[1]

Kind of food material.	Reference number.	Nitrogen.	Protein.[2]	Fat.	Carbohydrates.	Ash.
ANIMAL FOOD.						
Beef:		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Chuck steak	19	8.92	55.2	42.1	....	2.7
Loin	82	6.95	42.5	55.1	....	2.4
Sirloin	83	8.07	49.8	47.5	....	2.7
Do	84	7.58	46.9	50.6	....	2.5
Do	85	7.04	43.0	54.5	....	2.5
Average	....	....	46.6	50.8	....	2.6
Rump roast	262	9.58	50.7	46.7	....	2.6
Do	270	6.31	38.3	59.7	....	2.0
Average	....	....	44.5	53.2	....	2.3
Mutton: Leg	1550	8.09	49.6	47.8	....	2.6
Pork:						
Roast	2024	5.80	25.7	72.8	....	1.5
Steak	2139	3.06	11.5	87.8	....	.7
Head cheese	2010	5.60	34.5	59.4	....	6.1
Sausage	2527	3.03	13.0	83.9	....	3.1
Do	2528	5.12	20.3	75.7	....	4.0
Do	2530	5.19	33.3	60.4	....	6.3
Average	....	....	22.2	73.3	....	4.5
Poultry: Goose	2709	6.77	15.8	83.1	....	1.1
Butter	....	....	1.4	93.8	....	4.8
Milk	....	....	29.4	38.6	26.8	5.2
Do	....	....	26.7	32.7	35.3	5.3
Do	....	....	27.6	35.5	31.6	5.3
Average	....	....	27.9	35.6	31.2	5.3

[1]Analyzed at the New Jersey State Agricultural Experiment Station.
[2]Protein in all animal foods except milk was obtained by subtracting the sum of water, fat, and ash from 100. In milk and vegetable foods, nitrogen × 6.28=protein.

TABLE 15.—*Composition of water-free substance of edible portion of food materials*[1]—Continued.

Kind of food material.	Reference number.	Nitrogen.	Protein.[2]	Fat.	Carbohydrates.	Ash.
VEGETABLE FOOD.		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Flour, wheat	5253	....	12.6	1.1	85.8	.5
Flour, Hecker's prepared	5284	....	10.2	1.6	82.7	5.5
Bread, white, Leppert's	5335	....	14.2	2.8	81.4	1.6
Sugar, granulated	....	....	....	....	100.0	....
Cocoanut, shredded	8097	....	6.2	52.5	40.1	1.2
Beans, lima, dried	6516	....	14.6	2.2	79.1	4.1
Celery	6564	....	25.0	1.8	53.6	19.6
Peas, dried	6594	....	27.2	1.5	68.4	2.9
Succotash, canned	7096	....	16.7	4.5	76.1	2.7
Prunes, dried	8076	....	2.9	1.1	93.9	2.1

[1] Analyzed at the New Jersey State Agricultural Experiment Station.
[2] Protein in all animal foods except milk was obtained by subtracting the sum of water, fat, and ash from 100. In milk and vegetable foods, nitrogen × 6.25 = protein.

The figures in Table 16, giving the actual amounts of food and of nutrients in the food used during the dietary, are based upon the weights of the food materials as they were purchased and used; that is, they include bone and other refuse, except where specified.

The first three columns in the table contain the percentages of protein, fat, and carbohydrates used in computing the amounts of these nutrients in the different food materials. In all cases where the composition was not fairly well known from previous analyses, specimens of the food materials actually used in the dietary, or specimens as nearly identical as possible, were analyzed. The cases in which special analyses were made in connection with these dietaries are indicated in the table by placing the letter (*a*) after the name of the material. The weights of the water-free table and kitchen wastes, and their composition, are given in the last line of the table.

Table 17 contains a summary of the data given in Table 16, stated in pounds as well as in grams. It was estimated that the food consumption was equivalent to that of one man for 127 days. The table gives the quantities per man per day calculated on this basis.

The proportions of the several kinds of food materials in the dietary and the relative proportions of the several nutrients furnished by each are expressed in percentages in the last third of the table. Thus in the column under "Protein" it will be seen that "Beef, veal, and mutton" furnished 27.7 per cent of the protein; "Pork, lamb, etc.," 15.4 per cent, and the other animal foods enough so that all of the animal foods supplied 60 per cent of the protein of the food, and so on.

Table 18 gives the nutrients and potential energy in food purchased, in table and kitchen wastes, and in the portion actually eaten. The methods used in estimating the nutrients in the waste were similar to those described in previous publications of this Office.[1]

[1] U. S. Dept. Agr., Office of Experiment Stations Bul. 29, p. 14.

DIETARY STUDY OF A MECHANIC'S FAMILY IN NEW JERSEY (NO. 50).

The study began January 3, 1895, and continued twenty-one days.
The members of the family and number of meals taken were as follows:

	Meals.
Man 42 years old	63
Woman 37 years old (63 meals × 0.8 meal of man), equivalent to	50
Boy 17 years old (63 meals × 0.8 meal of man), equivalent to	50
Girl 15 years old (63 meals × 0.7 meal of man), equivalent to	44
Boy 13 years old (63 meals × 0.6 meal of man), equivalent to	38
Boy 10 years old (63 meals × 0.6 meal of man), equivalent to	38
Girl 9 years old (63 meals × 0.5 meal of man), equivalent to	32
Boy 8 years old (63 meals × 0.5 meal of man), equivalent to	32
Man 70 years old	29
Guest, man	2
Guest, woman (4 meals × 0.8 meal of man), equivalent to	3
Total number of meals taken equivalent to	381

Equivalent to one man 127 days.

Remarks.—The father is a well-paid mechanic, and the living expenses are probably fairly representative of a large class in New Brunswick, N. J. His work consists in getting rolls of paper in shape for shipment from a paper mill, and is rather active and quite heavy.

TABLE 16.—*Composition and amounts of food materials and table and kitchen wastes in dietary of a mechanic's family in New Jersey (dietary No. 50).*

Kind of food material.	Protein.	Fat.	Carbohydrates.	Total cost.	Total food material.	Nutrients. Protein.	Nutrients. Fat.	Nutrients. Carbohydrates.
ANIMAL FOOD.								
Beef:	*Per ct.*	*Per ct.*	*Per ct.*	*Dollars.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
Chuck steak (*a*)	16.3	12.4		0.61	2,295	374	285	
Rump roast (*a*)	17.5	16.1		.84	3,800	665	612	
Do (*a*)	15.3	23.9		.59	2,695	412	644	
Sirloin steak (*a*)	16.9	21.9		.38	965	163	211	
Do (*a*)	19.0	18.1		.36	905	172	164	
Do (*a*)	16.4	17.8		.91	2,295	376	409	
Do (*a*)	17.9	22.7		.89	2,240	401	508	
Suet	4.8	79.9			765	37	611	
Total				4.58	15,960	2,600	3,444	
Mutton: Leg (*a*)	17.1	16.5		1.84	5,955	1,018	983	
Pork:								
Roast (*a*)	10.7	30.4		.99	4,480	479	1,362	
Steak (*a*)	6.8	52.2		.55	2,495	170	1,302	
Bacon	9.2	61.8		1.06	3,005	276	1,857	
Head cheese (*a*)	19.4	33.4		.76	2,890	561	965	
Sausage (*a*)	17.9	32.5		.41	1,845	330	600	
Do (*a*)	8.8	56.8		.20	935	82	531	
Do (*a*)	12.1	45.0		.20	905	110	407	
Total				4.17	16,555	2,008	7,024	
Poultry:								
Goose (*a*)	7.2	37.8		2.25	5,640	406	2,132	
Goose, fat (*a*)		100.0			55		55	
Total				2.25	5,695	406	2,187	
Fish, etc.:								
Weakfish	8.4	1.1		.08	440	37	5	
Whitefish	10.3	3.0		.27	1,235	127	37	
Oysters	6.1	1.4	3.3	.43	1,320	81	18	44
Total				.78	2,990	245	60	44

TABLE 16.—*Composition and amounts of food materials and table and kitchen wastes in dietary of a mechanic's family in New Jersey (dietary No. 50)*—Continued.

Kind of food material.	Protein.	Fat.	Carbohydrates.	Total cost.	Total food material.	Nutrients.		
						Protein.	Fat.	Carbohydrates.
	Per ct.	*Per ct.*	*Per ct.*	*Dollars.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
Eggs	13.1	9.5	....	1.55	2,920	383	277	....
Butter (*a*)	1.3	84.0	....	1.27	1,920	25	1,613	....
Cheese	24.9	34.3	0.8	.50	1,415	352	485	11
Milk (*a*)	4.0	4.9	5.3	1.60	18,085	723	886	959
Milk, condensed	8.2	7.1	52.3	.27	1,220	100	87	638
Total animal food	....	....	....	18.81	72,720	7,860	17,046	1,652
VEGETABLE FOOD.								
Cereals, sugar, etc.:								
Flour (Hecker's) (*a*)	9.0	1.4	73.3	.24	2,195	197	31	1,609
Flour, wheat (*a*)	11.0	1.0	75.1	.60	13,665	1,503	137	10,262
Rice	7.8	.4	79.0	.12	540	42	2	427
Bread (white), Leppert's (*a*)	9.2	1.8	52.5	1.15	12,120	1,115	218	6,363
Bread (white, homemade) (*a*)	9.2	1.8	52.5	.06	595	55	11	312
Bread, rye	10.1	.7	55.9	.17	1,755	177	12	981
Cakes	7.0	8.1	63.4	.09	340	24	28	215
Cookies	6.8	8.9	75.3	.04	155	10	14	117
Ginger snaps	6.5	9.5	76.9	.37	1,405	91	133	1,080
Crackers	10.7	9.9	68.8	.38	1,430	153	141	984
Sugar, granulated (*a*)	....	....	99.9	1.86	16,895	....	....	16,878
Sugar, pulverized	....	....	99.9	.05	455	....	....	455
Chocolate	12.5	47.1	26.8	.01	30	4	14	8
Cocoa	21.6	28.9	37.7	.06	225	49	65	85
Cocoanut (*a*)	6.0	51.0	39.0	.03	140	8	71	55
Total	....	....	....	5.23	51,945	3,428	877	39,831
Vegetables:								
Beans, lima (*a*)	12.8	1.9	69.5	.19	710	91	13	493
Cabbage (23 per cent refuse)	2.1	.4	5.8	.30	4,185	88	17	242
Carrots (18 per cent refuse)	1.1	.5	9.0	.03	610	7	3	55
Celery (55 per cent refuse) (*a*)	1.4	.1	3.0	3.00	3,995	56	4	120
Onions (edible portion)	1.7	.4	9.9	.04	845	14	3	84
Onions (pickled)	1.7	.4	9.9	.14	410	7	2	40
Parsnips (28 per cent refuse)	1.7	.6	16.1	.05	530	9	3	85
Peas, dried (*a*)	23.9	1.3	60.1	.37	1,670	399	22	1,003
Peas, canned	3.6	.2	9.8	.94	2,840	102	6	278
Potatoes, white (38 per cent refuse)	2.1	.1	18.0	1.20	31,265	657	31	5,628
Succotash (*a*)	4.4	1.2	20.1	.42	1,260	55	15	253
Sweet potatoes (17 per cent refuse)	1.8	.7	27.1	.08	1,205	22	8	327
Tomatoes, canned	1.2	.2	4.0	.27	3,075	37	6	123
Turnips (edible portion)	1.4	.2	8.7	.15	1,925	27	4	167
Total	....	....	....	7.18	54,525	1,571	137	8,898
Fruits, nuts, etc.:								
Apples (edible portion)	.5	.5	16.6	.60	10,120	51	50	1,680
Currants, dried	1.2	3.0	65.7	.12	470	6	14	309
Oranges (11 per cent refuse)	.8	.6	9.7	2.16	11,695	94	70	1,134
Peaches, preserved	.5	.2	5.3	.20	510	3	1	27
Prunes (*a*)	2.1	.8	68.1	.24	905	19	7	616
Raisins	2.5	4.7	74.7	.16	440	11	21	329
Strawberries, preserved	.8	2.1	56.4	.25	480	4	10	271
Total	....	....	....	3.73	24,620	188	173	4,366
Total vegetable food	....	....	....	16.14	131,090	5,187	1,187	53,095
Total food	....	....	....	34.95	203,810	13,047	18,233	54,747

TABLE 17.—*Recapitulation of weights and percentages of food materials and nutritive ingredients used in dietary of a mechanic's family in New Jersey (dietary No. 50).*

Kind of food material.	Food material.	Nutrients.			Food material.	Nutrients.			Cost.
		Protein.	Fat.	Carbohydrates.		Protein.	Fat.	Carbohydrates.	
FOR FAMILY 21 DAYS.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Dolls.*
Beef, veal, and mutton	21,915	3,618	4,427	....	48.3	8.0	9.8	....	6.42
Pork, lard, etc	16,555	2,008	7,024	....	36.5	4.4	15.5	....	4.17
Poultry	5,695	406	2,187	....	12.6	.9	4.8	....	2.25
Fish, etc	2,995	245	60	44	6.6	.5	.1	0.1	.78
Eggs	2,920	383	277	....	6.4	.8	.6	....	1.55
Butter	1,920	25	1,613	....	4.2	.1	3.6	....	1.27
Cheese	1,415	352	485	11	3.1	.8	1.1	....	.50
Milk	18,085	723	886	959	39.9	1.6	1.9	2.1	1.60
Milk, condensed	1,220	100	87	638	2.7	.2	.2	1.4	.27
Total animal food	72,720	7,860	17,046	1,652	160.3	17.3	37.6	3.6	18.81
Cereals, sugars, starches	51,945	3,428	877	39,831	114.5	7.6	1.9	87.8	5.23
Vegetables	54,525	1,571	137	8,898	120.2	3.5	.3	19.6	7.18
Fruits	24,620	188	173	4,366	54.3	.4	.4	9.7	3.73
Total vegetable food	131,090	5,187	1,187	53,095	289.0	11.5	2.6	117.1	16.14
Total food	203,810	13,047	18,233	54,747	449.3	28.8	40.2	120.7	34.95
PER MAN PER DAY.									
Beef, veal, and mutton	173	28	35	....	.38	.06	.08	....	....
Pork, lard, etc	130	16	55	....	.29	.04	.12	....	....
Poultry	45	3	17	....	.10	.01	.04	....	....
Fish, etc	24	2	....	....	.05	....	....	....	....
Eggs	23	3	2	....	.05	.01	....	....	....
Butter	15	....	13	....	.03	....	.03	....	....
Cheese	11	3	4	....	.03	.01	.01	....	....
Milk	142	6	7	8	.31	.01	.02	.02	....
Milk, condensed	10	1	1	5	.02	....	....	.01	....
Total animal food	573	62	134	13	1.26	.14	.30	.03	.15
Cereals, sugars, starches	409	27	7	314	.90	.06	.02	.70	....
Vegetables	429	12	1	70	.94	.03	....	.15	....
Fruits	194	2	2	34	.43	....	....	.07	....
Total vegetable food	1,032	41	10	418	2.27	.09	.02	.92	.13
Total food	1,605	103	144	431	3.53	.23	.32	.95	.28
PERCENTAGES OF TOTAL FOOD.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*					*Per ct.*
Beef, veal, and mutton	10.8	27.7	24.3	....	....	....	....	....	18.4
Pork, lard, etc	8.1	15.4	38.5	....	....	....	....	....	11.9
Poultry	2.8	3.1	12.0	....	....	....	....	....	6.5
Fish, etc	1.5	1.9	.3	.1	....	....	....	....	2.2
Eggs	1.4	2.9	1.5	....	....	....	....	....	4.4
Butter	.9	.2	8.8	....	....	....	....	....	3.6
Cheese	.7	2.7	2.7	....	....	....	....	....	1.4
Milk	8.9	5.5	4.9	1.7	....	....	....	....	4.6
Milk, condensed	.6	.8	.5	1.2	....	....	....	....	.8
Total animal food	35.7	60.2	93.5	3.0	....	....	....	....	53.8
Cereals, sugars, starches	25.5	26.3	4.8	72.8	....	....	....	....	15.0
Vegetables	26.7	12.0	.8	16.2	....	....	....	....	20.5
Fruits	12.1	1.5	.9	8.0	....	....	....	....	10.7
Total vegetable food	64.3	39.8	6.5	97.0	....	....	....	....	46.2
Total food	100.0	100.0	100.0	100.0	....	....	....	....	100.0

TABLE 18.—*Nutrients and potential energy in food purchased, rejected, and eaten in dietary of a mechanic's family in New Jersey (dietary No. 50).*

Kind of food material.	Cost.	Nutrients.			Fuel value.
		Protein.	Fat.	Carbohydrates.	
Food purchased:	*Dollars.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
Animal	18.81	7,860	17,046	1,652	197,530
Vegetable	16.14	5,187	1,187	53,095	249,990
Total	34.95	13,047	18,233	54,747	447,520
Waste:					
Animal	....	342	774	....	8,600
Vegetable	....	77	17	791	3,715
Total	....	419	791	791	12,315
Food actually eaten:					
Animal	....	7,518	16,272	1,652	188,930
Vegetable	....	5,110	1,170	52,304	246,275
Total	....	12,628	17,442	53,956	435,205
PER MAN PER DAY.					
Food purchased:					
Animal	15	62	134	13	1,555
Vegetable	.13	41	10	418	1,975
Total	.28	103	144	431	3,530
Waste:					
Animal	....	3	6	....	70
Vegetable	....	....	....	6	25
Total	....	3	6	6	95
Food actually eaten:					
Animal	....	59	128	13	1,485
Vegetable	....	41	10	412	1,950
Total	....	100	138	425	3,435
PERCENTAGES OF TOTAL FOOD PURCHASED.					
Food purchased:	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Animal	53.8	60.2	93.5	3.0	44.1
Vegetable	46.2	39.8	6.5	97.0	55.9
Total	100.0	100.0	100.0	100.0	100.0
Waste:					
Animal	....	2.6	4.2	....	1.9
Vegetable	....	.6	.1	1.4	.8
Total	....	3.2	4.3	1.4	2.7
Food actually eaten:					
Animal	....	57.6	89.3	3.0	42.2
Vegetable	....	39.2	6.4	95.6	55.1
Total	....	96.8	95.7	98.6	97.3

COST OF FOOD.

The prices paid for the various articles of food used by the family during the study are based upon the following table, which shows the price paid per pound, quart, or bushel for the various foods at the time of the study. The ordinary range of prices is also given for those articles which vary in price at different seasons of the year or at different markets:

TABLE 19.—*Cost of food materials in dietary of mechanic's family in New Jersey (dietary No. 50).*

Kind of food material.	Range in price.	Price paid.
ANIMAL FOOD.		
Beef:	*Cents.*	*Cents.*
Sirloin steak ..... per lb..	16 to 20	18
Chuck steak .... do....	9 to 13	12
Rump roast .... do....	8 to 11	10
Mutton: Leg .... do....	12 to 16	14
Pork:		
Roast .... do....	9 to 12	10
Steak .... do....	8 to 10	10
Sausage .... do....	8 to 10	10
Bacon .... do....	14 to 16	16
Head cheese .... do....	10 to 12	12
Poultry: Goose .... do....	14 to 18	18
Fish, etc.:		
Weakfish .... do....	5 to 10	8
Whitefish .... do....	5 to 10	8
Oysters .... per qt..	25 to 30	30
Eggs .... per doz..	18 to 36	34
Butter .... per lb..	22 to 35	30
Cheese .... do....	9 to 16	16
Milk .... per qt..	6 to 8	8
Condensed milk .. per lb..	....	10
VEGETABLE FOOD.		
Cereals, sugar, etc.:		
Flour (Hecker's) . per lb..	....	5
Wheat flour .... do....	1½ to 2	2
Rice .... do....	....	10
Bread (rye) .... per loaf..	....	7
Bread (white) .... do....	3 to 8	[1]4$\frac{3}{10}$
Cookies .... per lb..	....	12
Cakes .... do....	....	12
Crackers .... do....	....	12
Ginger snaps ...... do....	....	12
Sugar (granulated) . do....	5 to 6	5

Kind of food material.	Range in price.	Price paid.
VEGETABLE FOOD—cont'd.		
Cereals, sugars, etc.—Cont'd.		
Sugar (pulverized), per pound	*Cents.* 5 to 6	*Cents.* 5
Cocoanut .... per lb..	....	11
Chocolate .... do....	....	10
Cocoa .... do....	....	12½
VEGETABLES.		
Lima beans .... per can..	....	12
Cabbage .... per head..	....	5
Carrots .... per lb..	....	2½
Celery .... do....	....	18
Onions .... per qt..	....	6
Onions (pickled) ...... do....	....	30
Parsnips .... per lb....	....	3
Peas (dried) .... do....	....	10
Peas (canned) ...... per can..	....	15
Potatoes (white) .... per bu..	30 to 75	65
Sweet potatoes .... do....	50 to 150	150
Succotash .... per lb..	....	15
Tomatoes (canned) . per can..	8 to 12	10
Turnips .... per lb..	....	2½
FRUITS.		
Currants .... per lb..	....	12
Oranges .... per doz..	....	24
Peaches (preserved), per can	....	20
Raisins .... per lb..	....	16
Strawberries (preserved), per jar	....	25
Prunes .... per lb..	....	12

[1] Per pound.

DISCUSSION OF RESULTS.

It is of interest to compare the results of the dietary study of the mechanic's family in New Jersey with the results of like investigations made elsewhere. Nine dietary studies of mechanics' families have been made—one at Knoxville, Tenn.; one at Lafayette, Ind., and seven at Middletown, Conn. The families were those of carpenters, masons, a blacksmith, a machinist, and a tinsmith. In considering food and nutrients purchased, wasted, and eaten, the results of the New Jersey study are compared with the average results of the nine studies; in considering cost, the New Jersey study is compared with the average

of two studies (Tennessee and Indiana), no record of the cost of foods was kept in the seven other studies. In the following table the dietary standard suggested for a man at moderate work is also given:

TABLE 20.—*Comparison of cost of food and of nutrients purchased, wasted, and eaten in dietary of a mechanic's family in New Jersey, with average of other dietaries in Tennessee, Indiana, and Connecticut.*

	Cost.	Nutrients.			Fuel value.
		Protein.	Fat.	Carbohydrates.	
FOOD PURCHASED.					
In New Jersey:	*Cents.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
Animal	15	62	134	13	1,555
Vegetable	13	41	10	418	1,975
Total	23	103	144	431	3,530
In average of 9[1] other studies:					
Animal	12	68	157	20	1,820
Vegetable	9	46	8	423	2,000
Total	21	114	165	443	3,820
FOOD WASTED.					
In New Jersey	3	3	6	6	95
In average of 9 others	....	9	13	23	250
FOOD EATEN.					
In New Jersey	....	100	138	425	3,435
In average of 9 others	....	105	152	420	3,570
Proposed standard for man at moderate work (Atwater	....	125	....	....	3,500

[1] Cost includes averages of two studies only.

It will be seen that the New Jersey family consumed somewhat less protein, fat, and carbohydrates than the average of 9 other mechanics' families. The amount of protein consumed was somewhat less than the amount suggested in the dietary standard for a man at moderate work. The fuel value of the dietary agreed very nearly with the standard.

Of the food purchased 3.2 per cent of the protein, 4.3 per cent fat, 1.4 per cent carbohydrates, and 2.4 per cent of the energy were rejected in the table and kitchen wastes.

The cost of the food in the New Jersey study was somewhat greater than the average cost of food in two other dietary studies. In the New Jersey dietary two articles were purchased, namely, oranges and celery, which added comparatively little to the food value of the dietary, but increased the cost very materially. This family spent 14.8 per cent of the whole cost of the food for celery and oranges, and in return got only 1.2 per cent of the total protein and 1.4 per cent of the total fuel value. The oranges and celery certainly added to the attractiveness of the dietary, but the use of such articles of diet must of course be governed by the resources of the family.

following table the nutrients eaten, the fuel value and the nutritive ratio of the New Jersey mechanic's dietary and the average

dietaries of 9 other mechanics' families are compared with the average results of families of professional men and farmers and of students' clubs:

TABLE 21.—*Results of dietary study of mechanic's family in New Jersey and average of 9 other dietaries of mechanics' families, compared with average results of dietaries of families of professional men and farmers, and with students' clubs.*

	Nutrients.			Fuel value.	Nutritive ratio.
	Protein.	Fat.	Carbohydrates.		
	Grams.	*Grams.*	*Grams.*	*Calories.*	
Mechanic's family in New Jersey	100	138	425	3,435	1:7.4
Mechanics' families, average of 9 (Tenn., Ind., Conn.)	105	152	420	3,570	1:7.3
Families of professional men, average of 9 (Ind., Ill., Conn.)	104	122	428	3,315	1:6.8
Farmers' families, average of 5 (Vt., Conn.)	92	114	483	3,420	1:8.1
Students' clubs, average of 7 (Tenn., Mo., Conn.)	95	140	419	3,420	1:7.8

It will be seen that the New Jersey dietary does not differ more widely from the dietaries of professional men, farmers, and students' clubs than from the average dietaries of other mechanics' families.

The results at present available are not numerous enough to permit of an extended comparison.